Ontario

Ministry of
Transportation and
Communications

Pavement Maintenance Guidelines

Distresses, Maintenance Alternatives and Performance Standards

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Introduction

Ontario has one of the best highway systems anywhere. Years of effort and billions of dollars have been invested. In the past, the emphasis has been on new construction and upgrading of standards. But recently, tight budgets and rising prices have brought a change. Now, the emphasis is on *preserving* what we have by maintaining and prolonging the life of our highway pavements. This makes the role of pavement maintenance more important than ever before.

To make the maintenance task easier and more effective, a Task Force of experienced Ministry people has developed a *systematic* strategy for pavement maintenance. This book is part of that system. It is designed to suit the needs of field staff — the patrolmen, patrol supervisors, and District maintenance staff who have to make decisions every day. The book will help you to make the *best* decision, the one that is most cost-effective. By providing a complete set of guidelines, the book will also help you to make that decision *consistently.*

For the most part, the guidelines deal with short-term measures — problems that have to be fixed *right now.* But they can also be used to identify situations affecting the prolonged life of the pavement. These, of course,should be referred to the Regional geotechnical staff. Such problems are not directly addressed in this guidelines book. They are only identified.

The guidelines presented in this book contain the following elements:

1. Photographs of the different types of pavement distress (including shoulder and drainage problems). The various distresses are shown in different stages of development.
2. A method for classifying each type of distress according to its severity and extent of occurrence.
3. Lists of suitable treatments or maintenance alternatives for each condition. The lists also give the expected service life of each treatment.
4. Performance Standards that describe each treatment and detail the men, equipment and materials needed. They also show how much can be accomplished by the specified team and, in some cases, the maintenance procedure is illustrated by photographs.
5. A method is given to determine which maintenance alternative is most cost-effective by calculating the equivalent annual cost for each.

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1. How to Use the Guidelines

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Using the Guidelines

If all else fails, read the instructions!
Better still, read the instructions first.

That's what this chapter is for — to tell you how to use the guidelines that appear in the following chapters, to define some basic terms, and to explain why some things are done the way they are. This way, everyone will understand and apply the guidelines in a consistent way and we will move closer to our goal of consistent and comprehensive pavement maintenance.

The Condition Survey

Before explaining what we mean by "condition survey", let's explain what we *do not* mean . . .

- We do not mean in any way to trace the performance history of highway pavements.
- Nor do we mean to put maintenance people to work to satisfy a huge data bank somewhere. The intention of the condition survey is simply to assist field staff to identify and treat each pavement distress discovered during routine inspection. To do this, we have to classify each problem in simple words. We want to know two things: *How bad is it?* and *How big is it?*

There are three possible answers to "How bad is it?" They are: SLIGHT, MODERATE and SEVERE. The correct answer may be chosen by simply comparing the distress on the road with the photos of a similar distress in this guidelines book. The photos clearly show the three stages of severity for each problem.

The question "How big is it?" refers not to the size of the pothole but rather to what extent the road surface is covered with potholes (or any other kind of distress). This extent of occurrence is called *Density* and it is broken down into two simple categories: LOCAL and GENERAL.

"Local" is defined as *affecting less than 30% of the pavement surface.* In other words, the distress is spotted over localized areas only.

A "general" distress is defined as *affecting more than 30% of the pavement surface.* In other words, the distress occurs more or less evenly over the entire length of the pavement section.

These two classifications of distress density are summarized in the following table.

Classification of distress density

CLASS	GUIDELINES (Base on percent of surface area in the pavement section affected by distress)
LOCAL:	Less than 30% of pavement surface area is affected by distress; Distress is spotted over localized areas only.
GENERAL:	More than 30% of pavement surface area is affected by distress; Distress is spotted evenly over the entire length of the pavement section.

Alternative Treatments

Once a pavement distress has been properly identified and classified according to severity and density, the question arises: *What should be done about it?*

The answer is provided in the tables printed next to the photos of each type of distress in this book. For each type and classification of distress, maintenance treatments are recommended. These may range from the simple notation "No Action" to several possible alternatives. A brief description of each alternative is given and a Maintenance Performance Standard for each is specified by number. These Performance Standards are printed in full in the last chapter of this book. They give complete details on the recommended treatments (some even include photographs showing how it is done). This information can be used to determine which of the recommended alternatives is the most cost-effective.

Now, clearly, this is a simplified approach to selecting pavement maintenance alternatives. As such, it is neither perfect nor complete. There may be other solutions better suited, there may be some not covered in this book. That's why we offer *guidelines* not *rules*. We know there is no substitute for the knowledge and experience of the man in the field. But the guidelines offer him valuable assistance by recommending the most likely cost-effective treatments for the vast majority of situations.

Expected Life of Alternative

Obviously, if the safety or minimum comfort level of the travelling public is threatened by a pavement distress, something must be done. *RIGHT AWAY!* In short-term emergencies like this, fixing the problem is all that's important—even if it's just a temporary fix.

In the medium to long term, however, care must be taken to select the maintenance treatment that is most cost-effective. Before you choose an alternative, you have to ask: *How long will it last?* Again, the answer is provided by the tables in this book.

To compile the tables, we spoke to many MTC people with years of experience in the field and we asked them to estimate the expected service life of each treatment alternative. The "Expected Life" given in the tables is an average of these estimates. We think it's pretty close to being right. If experience shows otherwise, we are prepared to change, but for now, please consider the estimate given to be correct.

Equivalent Annual Cost

Our goal in pavement maintenance is to select the *best* treatment for each situation. By "best", we usually mean the most *cost-effective*. The costs of the recommended alternatives must therefore be compared.

This is easily done by using the Maintenance Function Classification code number given in the treatment tables. They correspond to the appropriate Performance Standard in Chapter 5. Simply look it up and you will find complete details on the manpower, equipment, and materials needed for each job and how much can be accomplished in one day's work. From this, you can calculate the unit cost of each recommended treatment alternative. . .

$$\frac{\text{MANPOWER + EQUIPMENT + MATERIALS}}{\text{ACCOMPLISHMENT PER DAY}} = \text{UNIT COST}$$

Unfortunately, knowing the unit cost isn't enough to make a good comparison because one treatment may cost the same as another but last twice as long. To take this difference in service life into account, you have to average the cost of a repair over the years until you have to do it again. This is called the *equivalent annual cost* and it is calculated like this. . .

$$\frac{\text{UNIT COST}}{\text{EXPECTED LIFE OF ALTERNATIVE (YRS)}} = \text{EQUIVALENT ANNUAL COST}$$

The treatment calculated to have the lowest equivalent annual cost is the most cost-effective of the alternatives and should be carried out unless other factors prevail (see next section).

Summary of Procedures for Condition Survey and Treatment Selection

The following steps summarize the procedure to be followed when using this *Guidelines* book:

Step 1. Drive over the pavement; watch for signs of distress. This will give you an overall impression of the pavement's condition and help to locate areas of distress that need to be looked at more closely.

Step 2. Stop and carefully examine each area of distress. Use the Guidelines to *identify* each distress, then *classify* according to *severity* (slight, moderate, severe) and determine the *density* of occurrence (local or general).

Step 3. Assess the *urgency* of the problem. For example, does it threaten the safety of the public?

Step 4. Decide on the *priority* of each distress. Which one should be repaired first, second, third. . .?

Step 5. Consult the *treatment tables* for each type of distress. If more than one method of treatment is recommended, calculate which alternative is most *cost-effective* (see page 2). *NOTE:*—Sometimes a distress may be so severe it must be fixed without delay. In this case the recommended treatment may or may not be practical. It is up to the man in the field to *make a decision* and perhaps make do with the resources at hand rather than wait until a better treatment can be organized.

Step 6. If a pavement section contains a mixture of several different distresses, the Guidelines may indicate several different treatments. Obviously, there are times when individual attention like this would be silly. So, pick the treatment that is most universal, the one that will fix everything at once.

Step 7. Decide if the selected treatments can be done by a patrol. Confirm your decision (*and* your choice of treatments) with the District Maintenance Supervisor. If the problem is too big for a patrol to handle, notify the District Office by sending them a *Maintenance Needs Report Form* (shown in Figure 2). When you fill out the form, make sure you put in *all important information.*

Step 8. Consider *other factors.* The treatments recommended in these Guidelines are usually correct but, occasionally, they may be altered in view of special circumstances such as urgency, class of road, availability of men, money, materials, etc... (see Figure 1). It is up to the man in the field to consider such things and make a judgement call on the importance of these "other factors."

Step 9. Stop reading about it; go and *DO IT!*

Figure 1. Procedures for Maintenance Staff

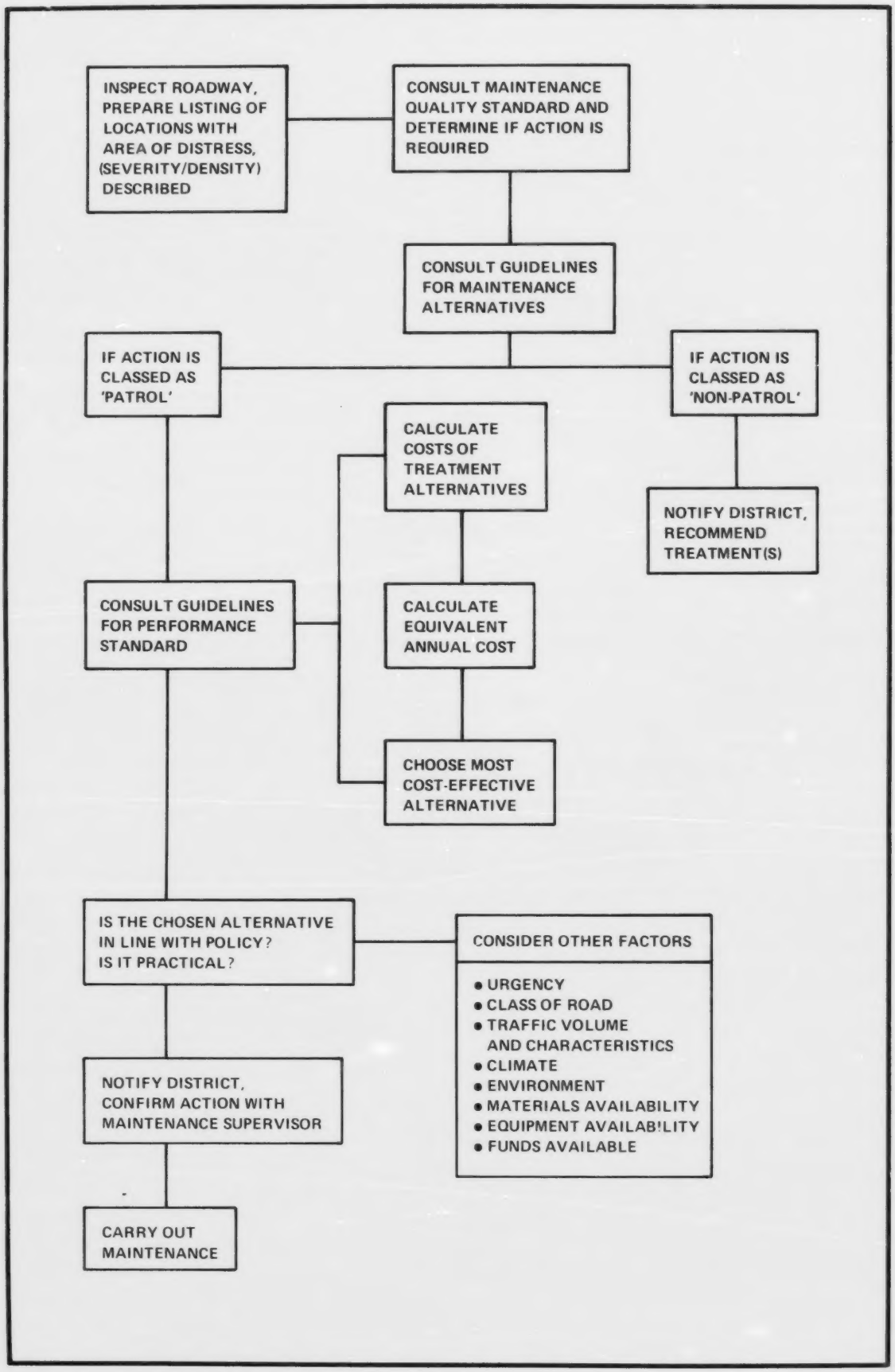
INSPECT ROADWAY, PREPARE LISTING OF LOCATIONS WITH AREA OF DISTRESS, (SEVERITY/DENSITY) DESCRIBED
CONSULT MAINTENANCE QUALITY STANDARD AND DETERMINE IF ACTION IS REQUIRED
CONSULT GUIDELINES FOR MAINTENANCE ALTERNATIVES
IF ACTION IS CLASSED AS 'PATROL'
IF ACTION IS CLASSED AS 'NON-PATROL'
CALCULATE COSTS OF TREATMENT ALTERNATIVES
NOTIFY DISTRICT, RECOMMEND TREATMENT(S)
CONSULT GUIDELINES FOR PERFORMANCE STANDARD
CALCULATE EQUIVALENT ANNUAL COST
CHOOSE MOST COST-EFFECTIVE ALTERNATIVE
IS THE CHOSEN ALTERNATIVE IN LINE WITH POLICY? IS IT PRACTICAL?
CONSIDER OTHER FACTORS
• URGENCY
• CLASS OF ROAD
• TRAFFIC VOLUME AND CHARACTERISTICS
• CLIMATE
• ENVIRONMENT
• MATERIALS AVAILABILITY
• EQUIPMENT AVAILABILITY
• FUNDS AVAILABLE
NOTIFY DISTRICT, CONFIRM ACTION WITH MAINTENANCE SUPERVISOR
CARRY OUT MAINTENANCE

Figure 2. Sample of Maintenance Needs Report

Ministry of Transportation and Communications
Ontario

HIGHWAY MAINTENANCE NEEDS REPORT

Date _____

LOCATION

District _____ Patrol _____ Highway _____
Surface ☐ Lane _____ Shoulder ☐ Roadside ☐ Drainage ☐
Bridge ☐ Safety Barrier ☐ Sign ☐ Fence ☐ Other ☐
At _____

CONDITION

Description _____
Severity _____
Density _____

PROBABLE CAUSES

RECOMMENDED REPAIRS

Include details of quantity estimates, suggested year of work, life expectancy of repair, etc.

PREVIOUS REPAIRS

Identify corrective treatment performed to date by Patrol or others ....

Signature of Patrolman

DISTRIBUTION: Copies 1 & 3 to District Maintenance Office; Copy 2 retain in Patrol Office.

ACTION TAKEN

Return Copy 3 to Patrol Office.

Signature of District Engineer

2. Distresses and Maintenance Treatments Flexible Pavement

Cracking	7
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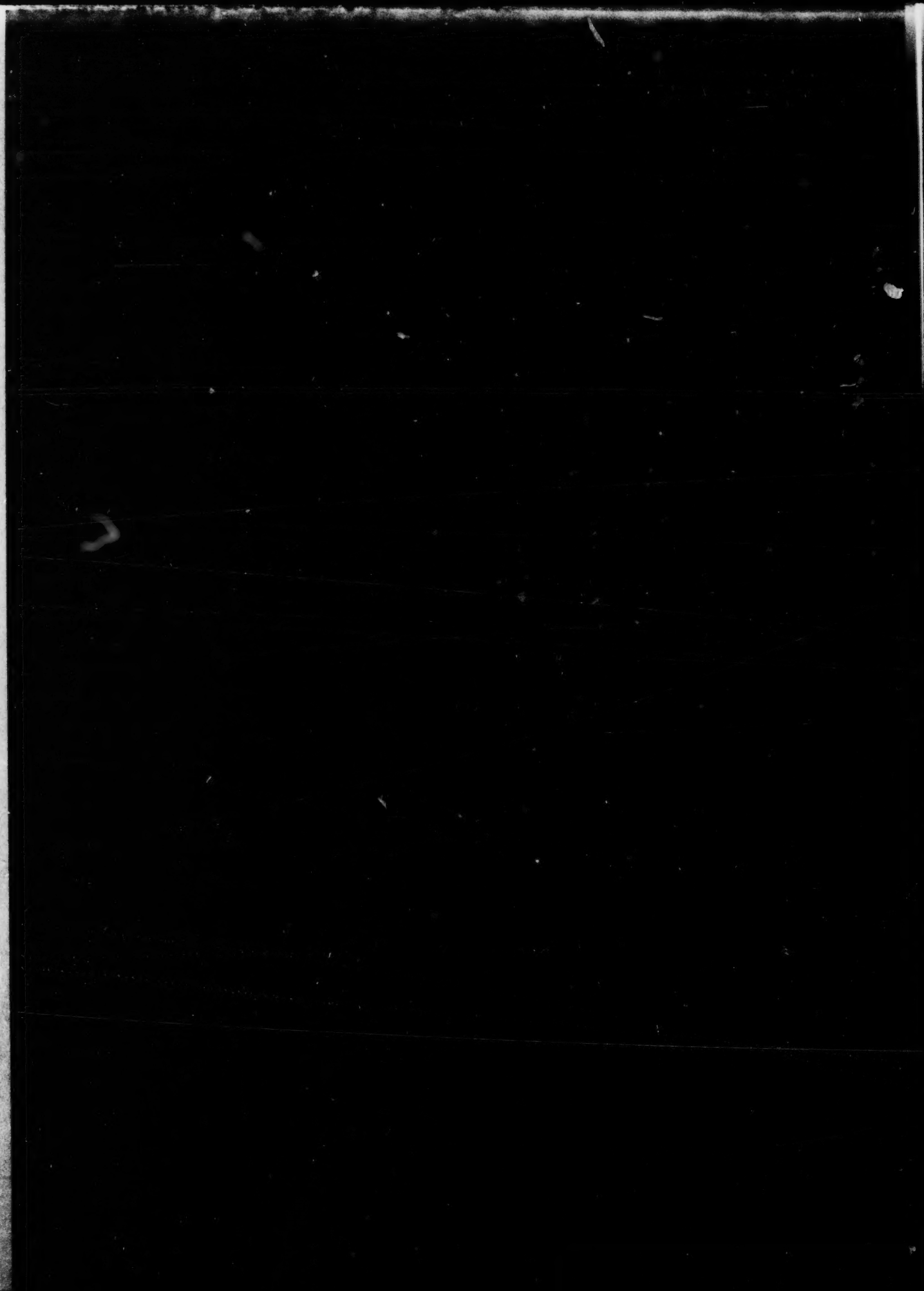
Progressive Edge Cracking/Edge Breaking	16
Surface Distortions	
Bump and Frost-Related Bump	20
Excessive Crown	21
Sagging, Dishing, Depression, Settlement	23
Surface Defects	
Flushing	24
Potholes	26
Ravelling/Streaking	28
Rippling/Shoving	30
Slippery Surface	32
Wheel Track Rutting	34



Cracking

Description:

Cracks follow a course approximately parallel to the direction of travel and are situated at or near the centre of the wheel tracks, centreline, mid-lane, pavement edges, etc.; or cracks follow a course approximately at right angles to the pavement centreline. Full transverse cracks tend to be regularly spaced along the length of the road; half-transverse and part-transverse cracks occur at shorter intermediate distance.

Possible causes:

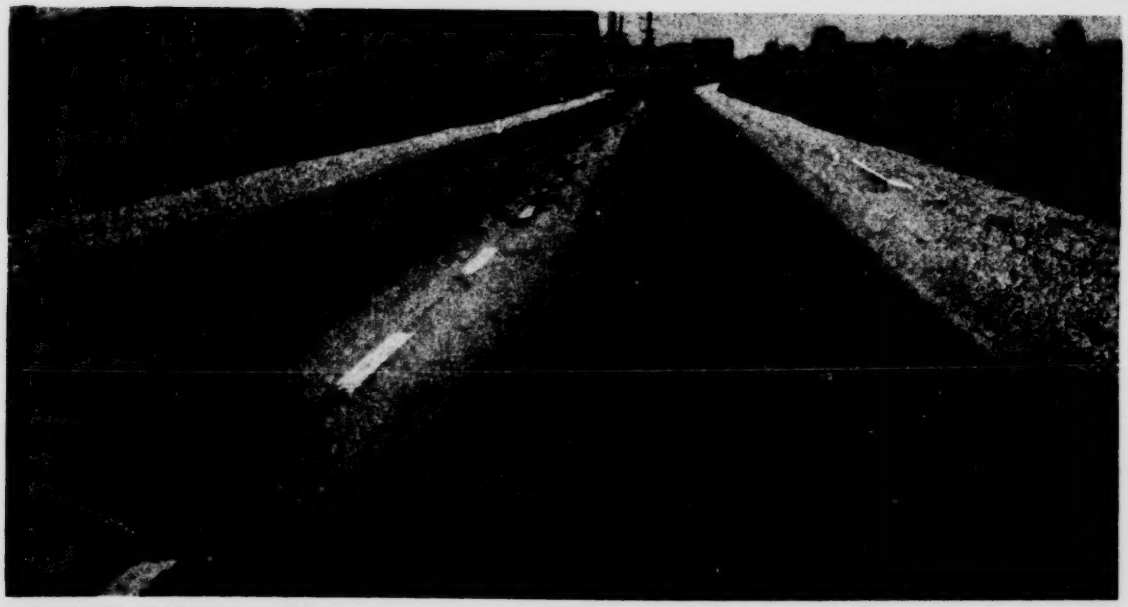
1. Traffic action (loading) combined with weak pavement.
2. Poor construction equipment and/or technique.
3. Environment and climatic conditions (frost action, moisture changes, etc.)
4. Poor drainage conditions at pavement and shoulder.
5. Natural shrinkage caused by very low temperatures.
6. High temperature susceptibility of asphalt cement binder in asphalt mixes.
7. Reflection cracks.

Severity:

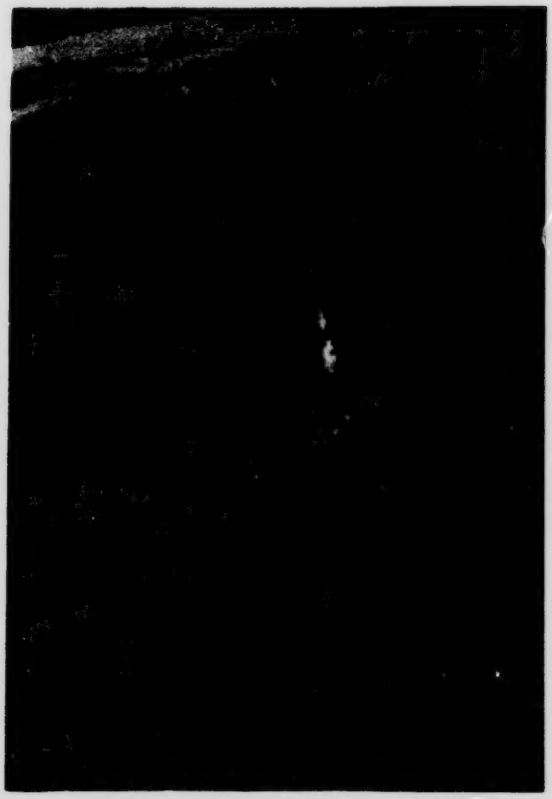
Class.	**Guidelines** (Base on crack width and its condition)
Slight	0.7 to 1 cm for standard granular base construction; 0.3 to 1 cm for soil cements base construction
Moderate	1 to 2 cm (single or multiple crackings)
Severe	More than 2 cm (single or multiple crackings with spalling beginning to develop)

Density:

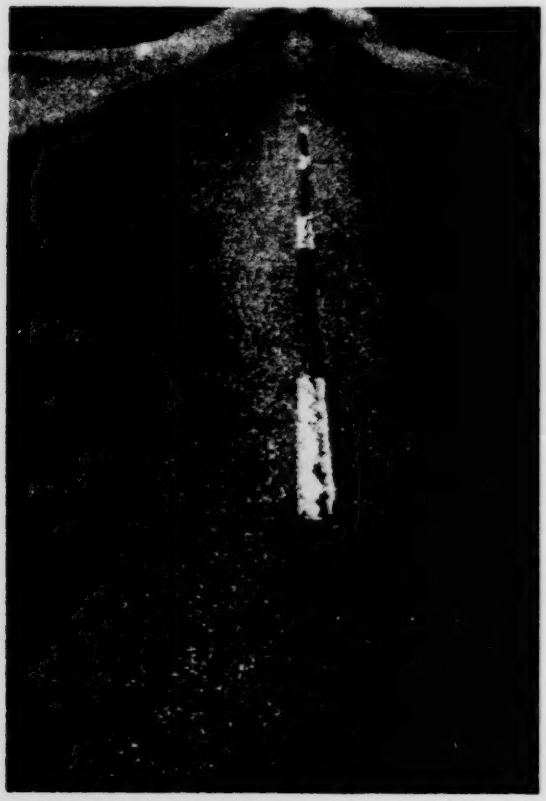
Local:	Less than 30% of pavement surface affected; distress spotted over localized areas only.
General:	More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.



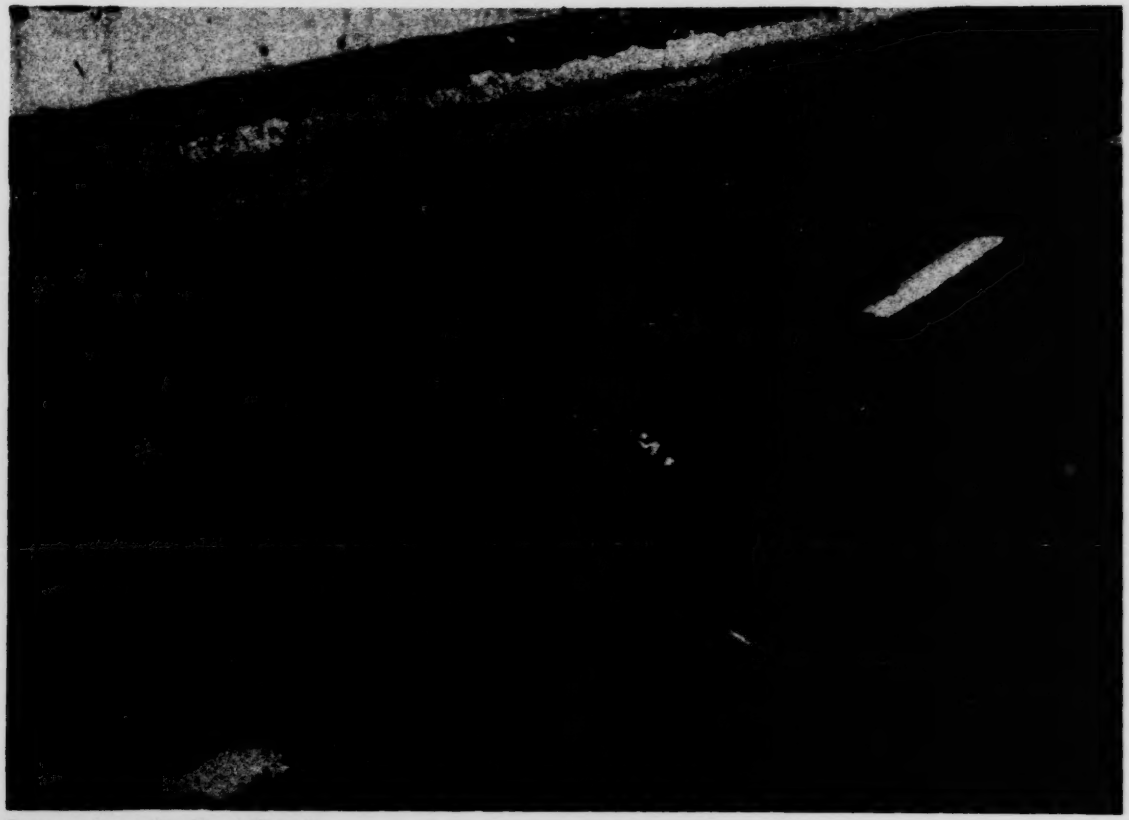
Longitudinal Mid-Lane Crack



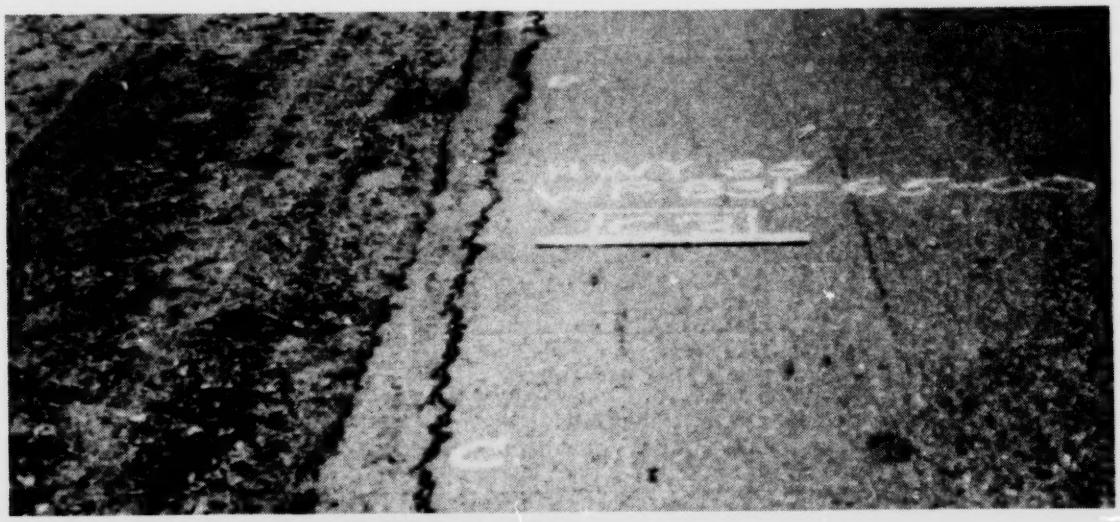
Moderate Multiple Longitudinal Cracking (Outer Wheel Path)



Typical Centreline Crack

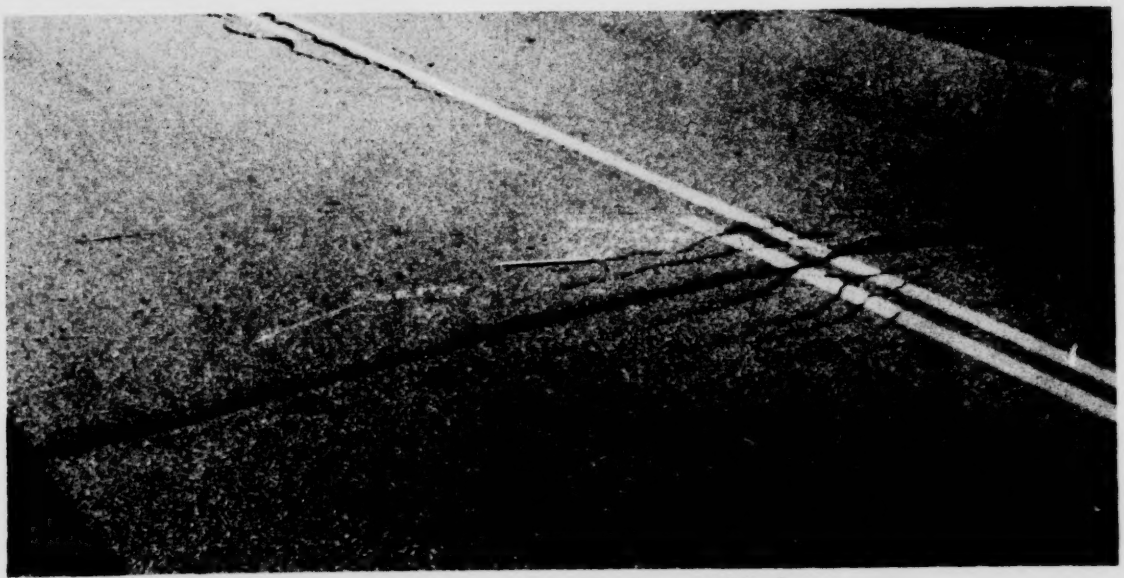


Severe Longitudinal Crack



Pavement Edge Crack (Longitudinal Formation)

Typical, Regularly-Spaced Transverse Cracks



Full Multiple Transverse Crack with Secondary Cracks and Lipping

Treatments for Cracking

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action if cracks are 0.7 to 1 cm (standard pavement)			
		Crack Seal if cracks are >0.3 cm (soil cement base pavement)			
	General	Same as above (standard pavement). For soil cement, notify District Office.			
Moderate	Local	Crack Seal if cracks are more than 1 cm (standard pavement)	1003		1
	General	Crack Seal and also notify District Office	1003	1003	1
Severe	Local	Crack Seal and also notify District Office	1003		1
	General	Notify District Office			

Alligator Cracking

Description:

Cracks form a network of multi-sided (polygon) blocks resembling the skin of an alligator. The block size can range from 5 to 10 cm to about 50 cm. The alligatored area may or may not be accompanied by distortion in the form of depression, and may occur anywhere on the pavement surface.

Possible causes:

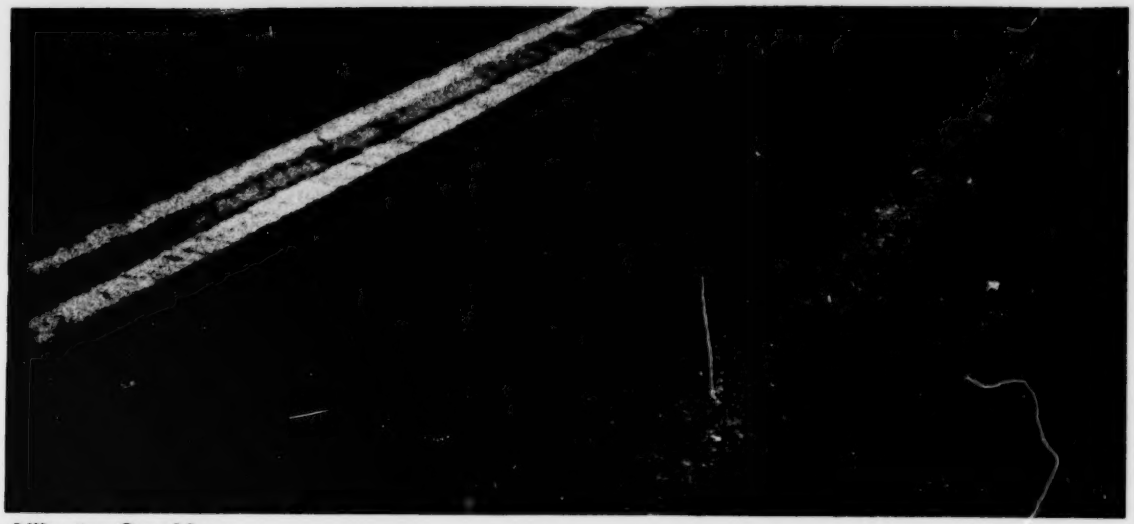
1. Insufficient pavement strength.
2. Poor base drainage and stiff or brittle asphalt mix at cold temperature.

Severity:

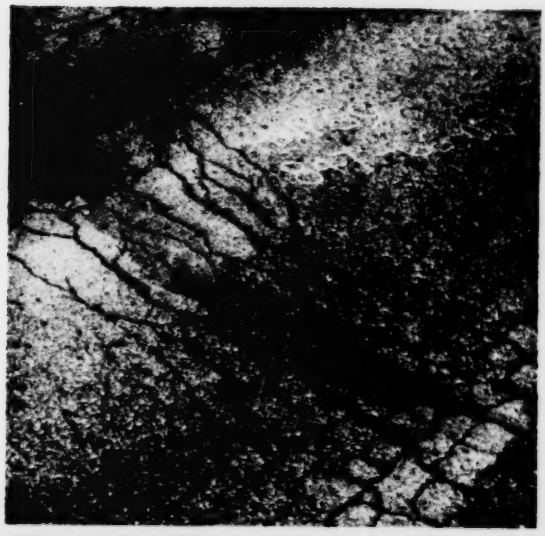
Class.	**Guidelines** (Base on appearance and surface distortion)
Slight	Alligator pattern established with corners of polygon blocks fracturing
Moderate	Alligator pattern established with spalling of polygon blocks
Severe	Polygon blocks begin to lift; may or may not involve potholes.

Density:

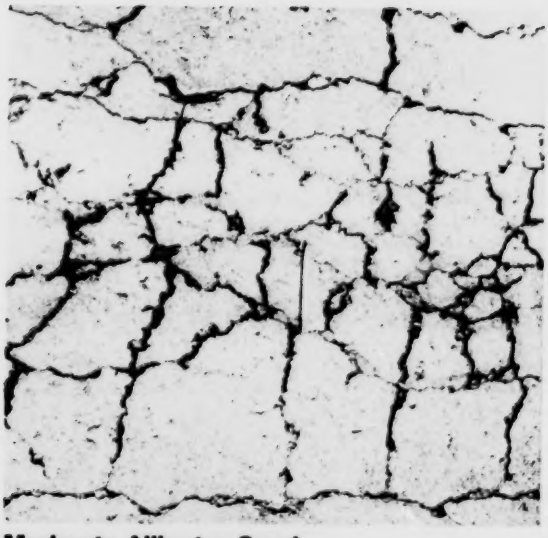
Local:	Less than 30% of pavement surface affected; distress spotted over localized areas only.
General:	More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.



Alligator Cracking



Alligator Cracking



Moderate Alligator Crack

Severe Alligator Crack

Severe Alligator Cracking

Treatments for Alligator Cracking

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action			
	General	No Action but monitor closely for future development			
Moderate	Local	Spray Patch	1004		1
		Cold Mix Patch	1001		1
		Hot Mix Patch	1001 1002	1002	4
		Hot Mix Patch for multi-lanes		1002	4
	General	Same as above but notify District Office of situation and maintain close monitoring			
Severe	Local	Cold Mix Patch	1001		0.5
		Hot Mix Patch	1001 1002	1002	3
		Excavate, Granular and Hot Mix Patch	1002	1002	7
		Improve Drainage (additional)	*	*	
	General	Hot Mix Patch for highways with AADT < 2000 and notify District Office	1002		2
		Mulching for AADT < 2000		1014	3
		Granular Lift and Surface Treatment for highways with AADT < 2000		1017	4
		Hot Mix Patch over selected areas and notify District Office for further action for highways with AADT > 2000	1002	1002	3

* Contract only.

Map Cracking

Description:	Crack runs randomly along the pavement surface, sometimes in a serpentine manner. The crack appears to have transverse and longitudinal cracks combined to form a map.	
Possible causes:	1. Swelling or shrinkage. 2. Frost action.	
Severity:	**Class.**	**Guidelines** (Base on crack width and its condition)
	Slight	0.7 to 1 cm for standard granular base construction; 0.3 to 1 cm for soil cement base construction
	Moderate	1 to 2 cm (single or multiple crackings)
	Severe	More than 2 cm (single or multiple crackings with spalling beginning to develop)
Density:	*Local:*	Less than 30% of pavement surface affected; distress spotted over localized areas only.
	General:	More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.

Map Cracking

Treatments for Map Cracking

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action			
	General	No Action			
Moderate	Local	No Action for highways with AADT < 2000			
		Notify District Office if highways have AADT > 2000			
	General	Sand Seal for highways with AADT < 2000		1017*	2
		Surface Treatment for highways with AADT < 2000		1017	3
		Hot Mix Patch for highways with AADT > 2000 (Must notify District Office for further investigative action before any work carried out)	1002	1002	4
Severe	Local	Sand Seal for highways with AADT < 2000 and notify District Office		1017*	1
		Surface Treatment for highways with AADT < 2000 and notify District Office		1017	2
		Hot Mix Patch for highways with AADT > 2000 and notify District Office	1002	1002	4
	General	Surface Treatment for highways with AADT < 2000		1017	2
		Single Course Hot Mix Resurfacing for highways with AADT > 2000		****	6
		No Action but notify District Office except Hot Mix Patch over selected areas	1002	1002	4

**** Non-routine maintenance task; contract only.

Progressive Edge Cracking/Edge Breaking

Description:

Cracks begin parallel to and within 30 cm of the pavement edge; cracking is either a fairly continuous straight crack or consists of crescent-shaped cracks in wave-formation. *Progressive edge cracking* will gradually encroach into the outer-wheel tracks, through the middle of the lane, and may even spread across to the centreline. *Edge breaking* occurs with or without cracks; it generally occurs in mulch or surface-treatment types of pavement surfaces.

Possible causes:

1. Frost action.
2. Insufficient pavement strength or excessive loading at the pavement edge.
3. Poor drainage at pavement edge and shoulder.
4. Inadequate pavement width forces traffic too close to pavement edge.

Severity:

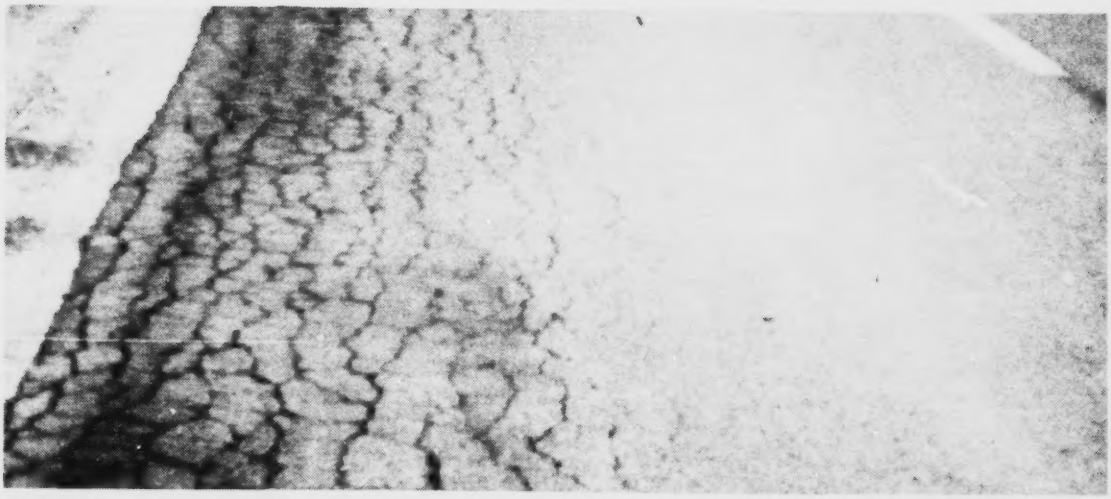
Class.	Guidelines (Base on extent to which cracks have multiplied and stage of development)
Slight	Less than 60 cm from pavement edge; single or two parallel cracks
Moderate	Extending over 60 cm but less than 90 cm from pavement edge; multiple cracks with connecting cracks
Severe	Extending more than 90 cm from pavement edge; alligatoring of pavement occurs at and near pavement edge

Density:

Local:	Less than 30% of pavement surface affected; distress spotted over localized areas only.
General:	More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.

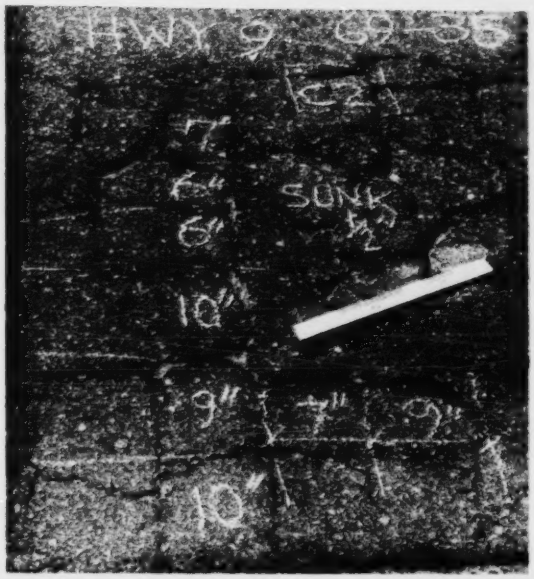
Pavement Edge Crack (Wave Formation)

Moderate Progressive Edge Cracking



Severe Progressive Edge Cracking

Moderate Progressive Pavement Edge Crack



Severe Progressive Pavement Edge Crack (Note Alligatoring of pavement already occurs)

Moderate Pavement Edge Breaking

Severe Pavement Edge Breaking

Treatments for Progressive Edge Cracking/Edge Breaking

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action			
	General	No Action but monitor for development			
Moderate	Local	Spray Patch	1004		1
		* Cold Mix Edge Patch	1001		2
	General	Spray Patch	1004		1
		* Cold Mix Edge Patch	1001		2
		Hot Mix Quarter Patch	1002	1002	
		Improve shoulder drainage (additional)		**	
		Notify District Office	x		
Severe	Local	Spray Patch	1004		1
		* Cold Mix Edge Patch	1001		2
		Hot Mix Quarter Patch	1001 1002		3
		* Cold Mix Edge Patch	1001		2
	General	Hot Mix Quarter Patch	1002	1002	2
		Hot Mix full width patch	1002	1002	3
		Single Course Hot Mix Resurfacing		****	4
		Improve shoulder drainage (additional)		**	
		Spot patch with Hot Mix and notify District Office	1001	1001	2

* This treatment is to be used only on mulch and surface treatment types of pavement surface.
** Contract only.
**** Non-routine maintenance task; contract only.

Surface Distortions

Description:

Any deviation of the pavement surface from its original shape (other than described for rippling, shoving and rutting). Generally, these distortions result from settlement, slope failure, volume changes due to moisture and frost heaving, and from residual effects of frost heaving accumulating after each winter. The resulting deformation may take the form of dishing, bumps, dips, tenting or stepping at cracks, all of which give rise to pitch and roll in a moving vehicle.

Possible causes:

1. Differential frost heave in poorly drained cuts and transitions.
2. Differential frost heave at pavement edges or road centre.
3. Reverse differential frost heave at culverts.
4. Differential settlement of subgrade or base materials.
5. Lack of subgrade support.
6. Embankment slope failure.

Severity:

Class.	**Guidelines** (Base on personal experience of the interaction between vehicle and pavement surface distortion).
Slight	Swaying or jarring motion but good control of vehicle still present for driver
Moderate	Fair control of vehicle when driven over pavement
Severe	Poor control of vehicle when driven over pavement; driver always has to anticipate distortion ahead

Density:

Local:	Less than 30% of pavement surface affected; distress spotted over localized areas only.
General:	More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.

Severe Bump

Severe Frost-Related Bump

Treatments for Bump and Frost-Related Bump

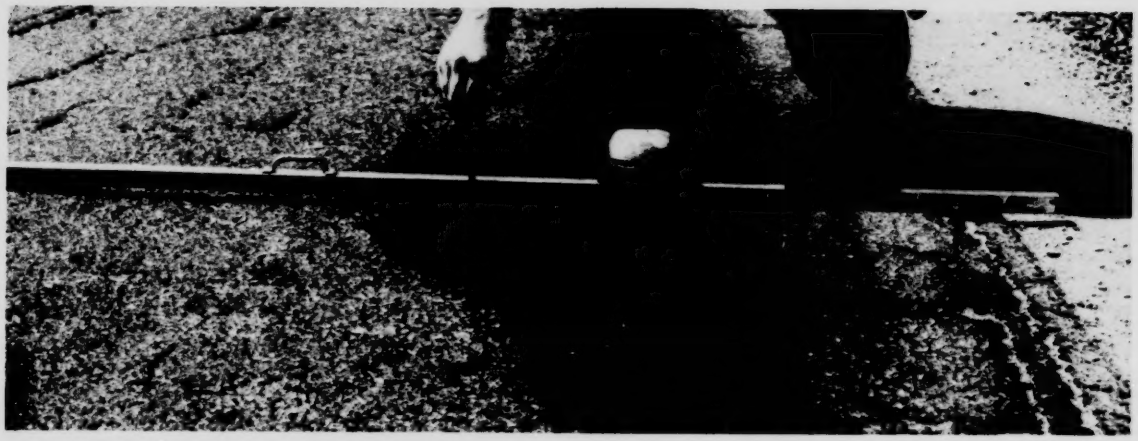
Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action			
Moderate	Local	Cold Mix Patch	1001		0.5
		Hot Mix Patch	1001 1002		2
Severe	Local	Cold Mix Patch and notify District Office	1001		0.5
		Hot Mix Patch and notify District Office	1002		2
		Heater Planing		1090H	
		Cold Planing		1090C	
		Cold Mix Patch and notify District Office for future action (e.g., excavate and back-fill with approved granular materials and hot-mix resurfacing in the spring	1001	1001	0.5

Excessive Crown

Treatments for Excessive Crown

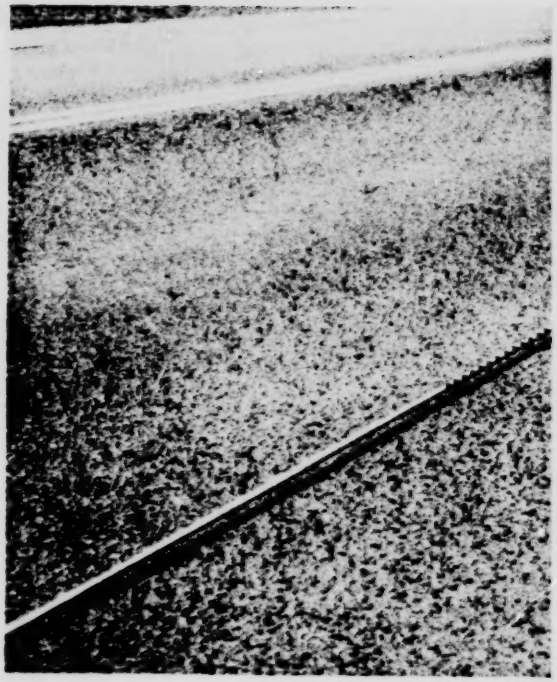
Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action			
	General	No Action but monitor for future development			
Moderate	Local	No Action			
	General	No Action but notify District Office			
Severe	Local	Cold Mix Patch full width or quarter width (quarter patch should be used only on highways with AADT < 2000)	1002		0.5
		Hot Mix Patch full width	1002	1002	6
		Hot Mix Patch quarter width	1002		3
	General	Cold Mix Patch full width on selected areas and notify District Office	1002		2
		Cold Mix Patch quarter width on selected areas and notify District Office (use only on highways with AADT < 2000)	1002		1
		Hot Mix Patch full width or selected areas and notify District Office	1002	1002	4
		Hot Mix Patch quarter width on selected areas and notify District Office (do not use on multi-lane highways)	1002		3

Severe Distortion

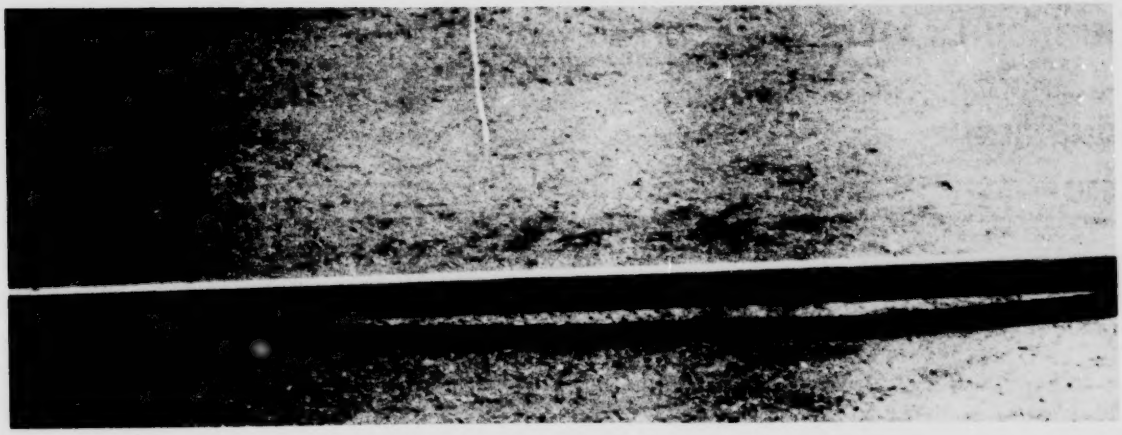


Severe Depression

Slippage Settlement



Sagging



Severe Dishing

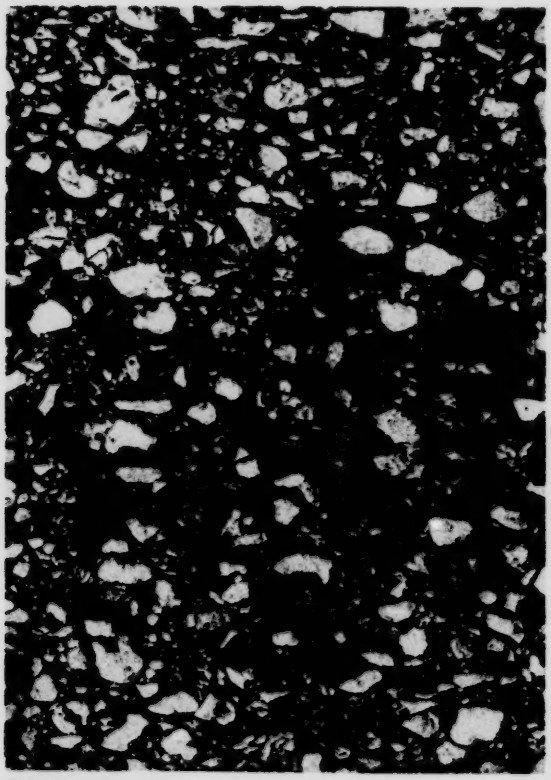
Treatments for Sagging, Dishing, Depression, Settlement

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action			
	General	No Action			
Moderate	Local	No Action			
	General	Cold Mix Patch and notify District Office	1001		0.5
		Hot Mix Patch and notify District Office	1001 1002	1002	2
Severe	Local	Cold Mix Patch	1001		0.5
		Hot Mix Patch	1001 1002	1002	
	General	Cold Mix Patch and notify District Office	1001		0.5
		Hot Mix Patch and notify District Office	1001 1002	1002	2.0

Surface Defects

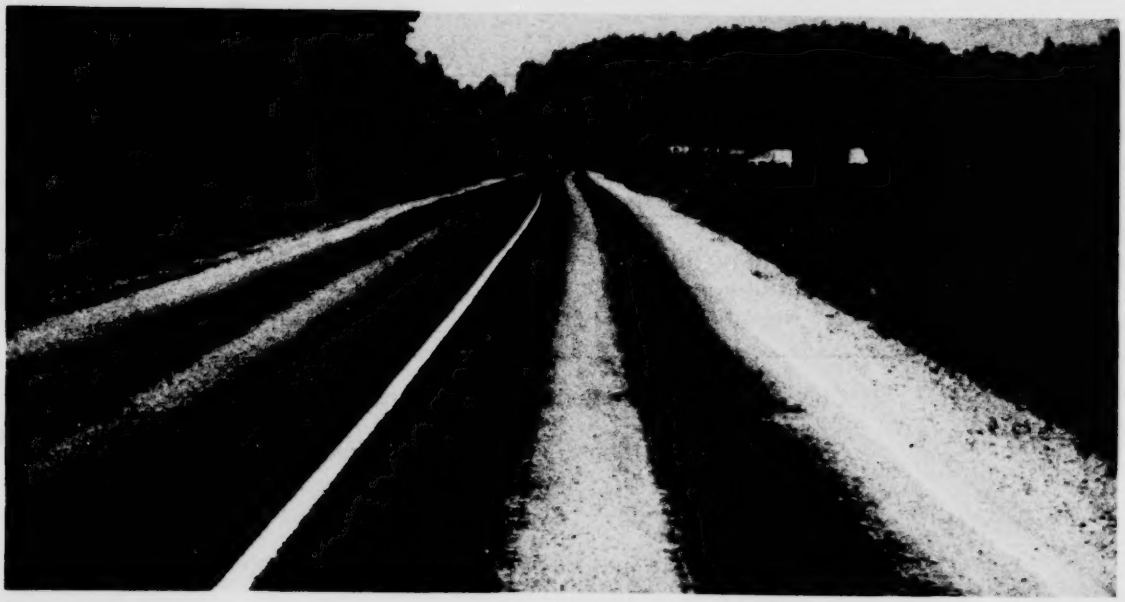
Flushing

Description:	Free asphalt migrating upward to the pavement surface. Most likely to occur in the wheel tracks, especially during hot weather.	
Possible causes:	1. Too much asphalt in mix; excess asphalt is forced to the pavement surface by traffic action. 2. Paving over flushed pavement with new asphalt without treating the flushed surface. 3. Paving over excess primed surfaces.	
Severity:	**Class.**	**Guideilnes** (Base on observation)
	Slight	Colouring of pavement surface *visible* (interconnected veining)
	Moderate	Distinctive appearance (with excess asphalt already free)
	Severe	Free asphalt gives the pavement surface a wet look; tire marks and tracking are evident; tire noise can be heard.
Density:	*Local:*	Less than 30% of pavement surface affected; distress spotted over localized areas only.
	General:	More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.



Slight Flushing

Moderate Flushing



Severe Flushing

Treatments for Flushing

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action			
	General	No Action			
Moderate	Local	No Action			
	General	No Action but notify District Office of the problem situation			
Severe	Local	Blotting with hot sand	1090B	1090B	
		Burn and Seal with fine aggregates for highways with AADT < 2000	1090B	1090B	2
		Burn and Hot Mix Patch for highways with AADT > 2000	1090B 1001	1090B 1002	4
	General	Burn and Sand Seal or Chip Seal for highways with AADT < 2000		1090B	2
		Burn and Single Course Hot Mix resurfacing for highways with AADT > 2000		1090B	6
		Burn and Hot Mix patch selected areas and notify District Office of the problem situation	1090B 1001	1090B 1002	4

Potholes

Description: Bowl-shaped holes in pavement; can be unrelated to other surface defects or a direct result of other defects such as ravelling, alligator cracking, etc.

Possible causes:

1. Poor construction technique and poor quality control.
2. Poor aggregates in pavement.
3. Result of other defects (ravelling, cracking, alligator cracking, etc.)

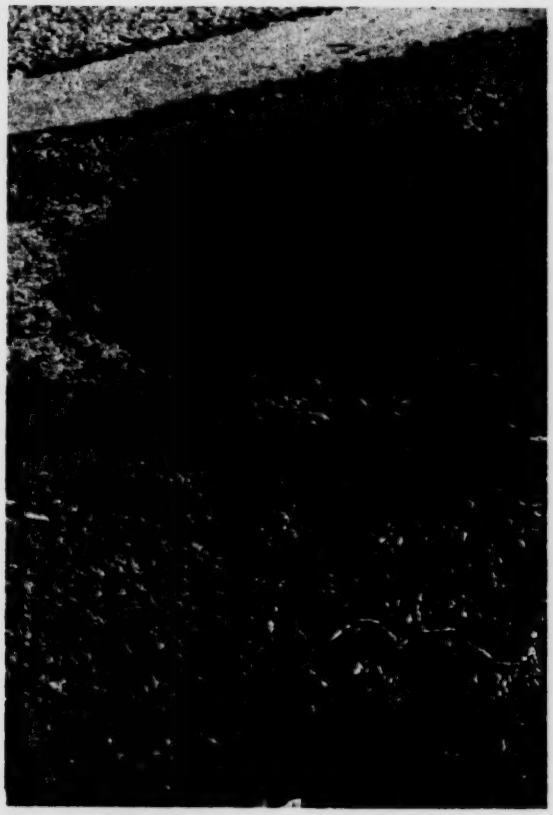
Severity:

Class.	**Guidelines** (Base on observation)
Slight	Less than 8 cm wide and shallow in depth
Moderate	8 to 30 cm wide and usually more than 5 cm deep
Severe	More than 30 cm wide and usually more than 10 cm deep

Density:

Local:	Less than 30% of pavement surface affected; distress spotted over localized areas only.
General:	More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.

Moderate Pothole



Severe Pothole

Treatments for Potholes

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	Spray Patch	1004		1.5
	General	Spray Patch	1004		1.5
Moderate	Local	Cold Mix Patch	1001		1
		Hot Mix Patch	1001 1002		2
	General	Cold Mix Patch	1001		1
		Hot Mix Patch	1001 1002		2
Severe	Local	Cold Mix Patch	1001		1
		Hot Mix Patch	1001 1002		2
	General	Cold Mix Patch with Sand Seal (for Highways with AADT < 2000)	1001	1017*	1.5
		Cold Mix Patch with surface treatment for highways with AADT < 2000	1001	1017	2
		Cold Mix Patch and notify District Office	1001		1
		Mulching over existing highway for highways with AADT < 2000		1014	3.5
		Granular Lift and Surface Treatment for highways with AADT < 2000		1017	4
		Hot Mix Patch and Surface Treatment for highways with AADT < 2000		1002 1017	3
		Hot Mix Patch and Single Course Hot Mix Resurfacing for highways with AADT > 2000		1002 ****	6
		Hot Mix Patch and notify District Office		1002	2

**** Non-routine maintenance task; contract only.

Ravelling/Streaking

Description: Progressive loss of pavement material from surface downward. Pavement surface looks as though it is breaking up into small pieces like peeling sunburn, or it has streak-like lines running parallel to the pavement centreline on a surface-treated road. Ravelling can occur over the entire surface, but the wheel tracks are generally the worst areas because of the traffic action.

Possible causes:

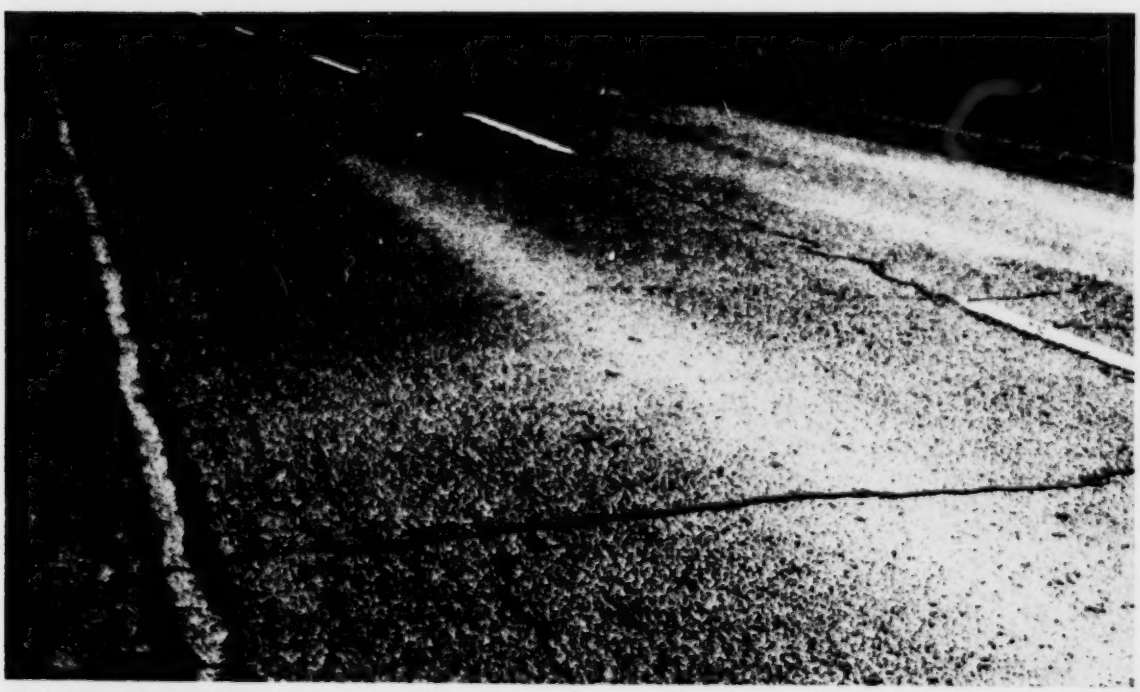
1. Poor construction technique and poor quality control.
2. Asphalt hardening due to aging.
3. Traffic action on a weak surface.

Severity:

Class.	**Guidelines** (Base on observation)
Slight	Noticeable loss of pavement material or faint streaking beginning to appear on surface of surface-treated pavement
Moderate	Shallow disintegration of pavement surface; an open textured look; or definite streaking on surface of surface-treated pavement
Severe	Shallow disintegration of pavement surface with small potholes, very open texture with loose materials; or heavy streaking on pavement surface and loose materials on surface-treated pavement

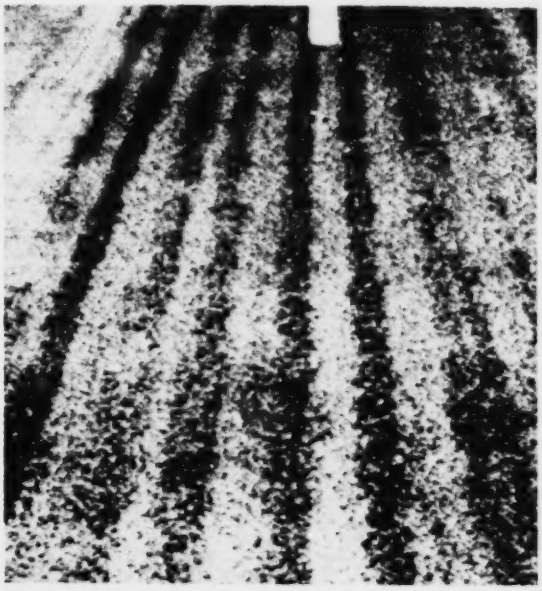
Density:

Local:	Less than 30% of pavement surface affected; distress spotted over localized areas only.
General:	More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.



Moderate Ravelling

Severe Ravelled Pavement Surface



Streaking of Surface-Treated Pavement

Treatments for Ravelling/Streaking

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action			
	General	No Action			
Moderate	Local	Spray Patch	1004		2
	General	Sand Seal for AADT < 2000		1017*	1.5
		Surface Treatment for highways with AADT < 2000		1017	3
		Hot Mix Patch selected areas and monitor for future deterioration if highway has AADT > 2000	1001 1002	1002	4
		No Action but inform District Office of the problem situation			
Severe	Local	Spray Patch	1004		1
		Hot Mix Patch	1001 1002	1002	4
	General	Surface Treatment for highways with AADT < 2000		1017	2.5
		Single Course Hot-Mix Resurfacing for highways with AADT > 2000		****	7
		Hot Mix Patch selected areas and notify District Office of the problem situation	1001 1002	1002	3

**** Non-routine maintenance task; contract only.

Rippling/Shoving

Description: Regular transverse undulations in the pavement surface consisting of closely spaced alternate valleys and crests; unevenness of pavement surface caused by traffic action moving surface mat forward, backward or sideways.

Possible causes:

1. Poor material design and construction technique; poor quality control.
2. Traffic action, such as stop and start at intersections.

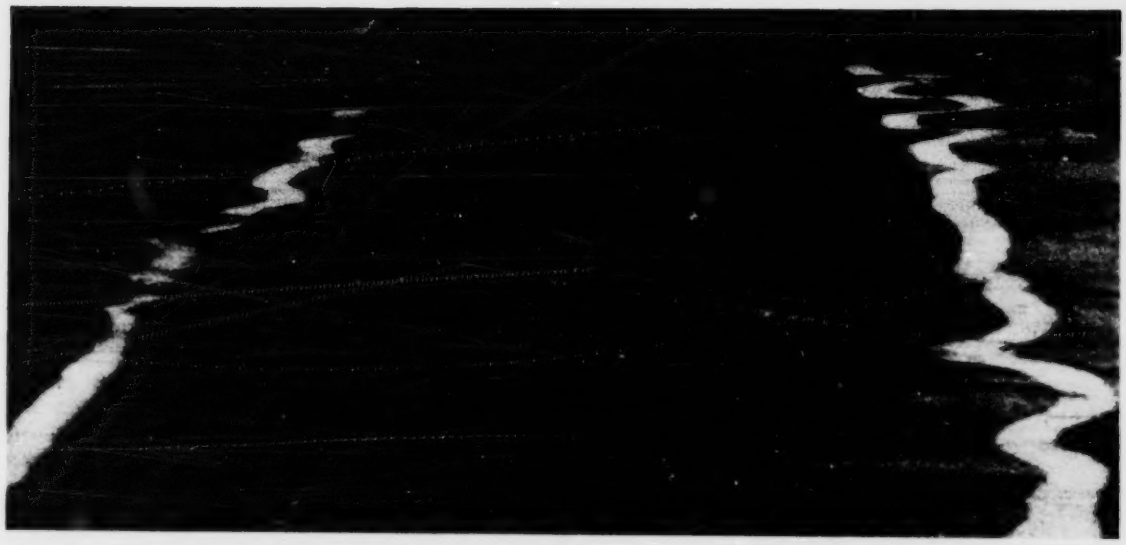
Severity:

Class.	**Guidelines** (Base on observation and effect onrideability)
Slight	Noticeable
Moderate	Rough ride
Severe	Very rough ride; loss of control of vehicle may result.

Density:

Local:	Less than 30% of pavement surface affected; distress spotted over localized areas only.
General:	More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.

Severe Rippling



Shoving (Caused by Horizontal Thrust of Wheels)

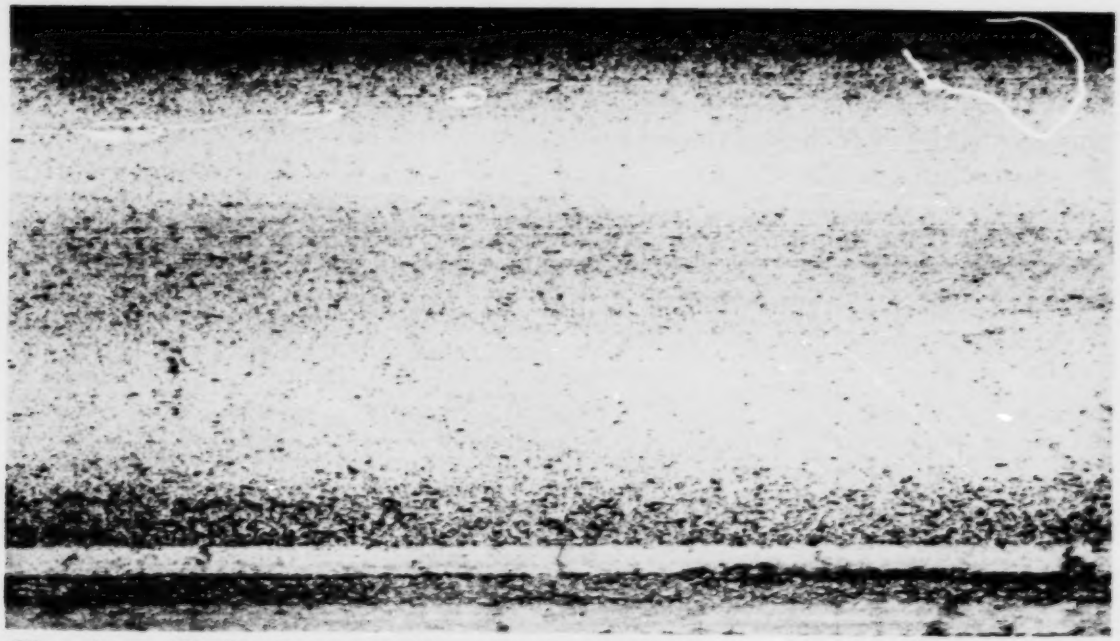
Treatments for Rippling/Shoving

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action			
	General	Monitor for future consideration			
Moderate	Local	Cold Mix Patch	1001		1
		Hot Mix Patch	1001 1002		2.5
	General	Notify District Office and:			
		Cold Mix Patch	1001		1
		Hot Mix Patch	1001 1002	1002	2.5
		Cold Planing		1090C	1
		Heater Planing		1090H	1
Severe	Local	Cold Mix Patch	1001		0.5
		Hot Mix Patch	1001 1002	1001 1002	2
		Cold Planing		1090C	
		Heater Planing		1090H	
	General	Mulching for highways with AADT < 2000		1014	3
		Granular Lift and Surface Treatment for highways with AADT < 2000		1017	3
		Hot Mix Patch only for highways with AADT < 2000		1001 1002	4
		Hot Mix Patch and One Course of Hot Mix Resurfacing for highways with AADT > 2000		1002 ****	6
		Hot Mix Patch only and notify District Office for highways with AADT > 2000	1001 1002	1002	2

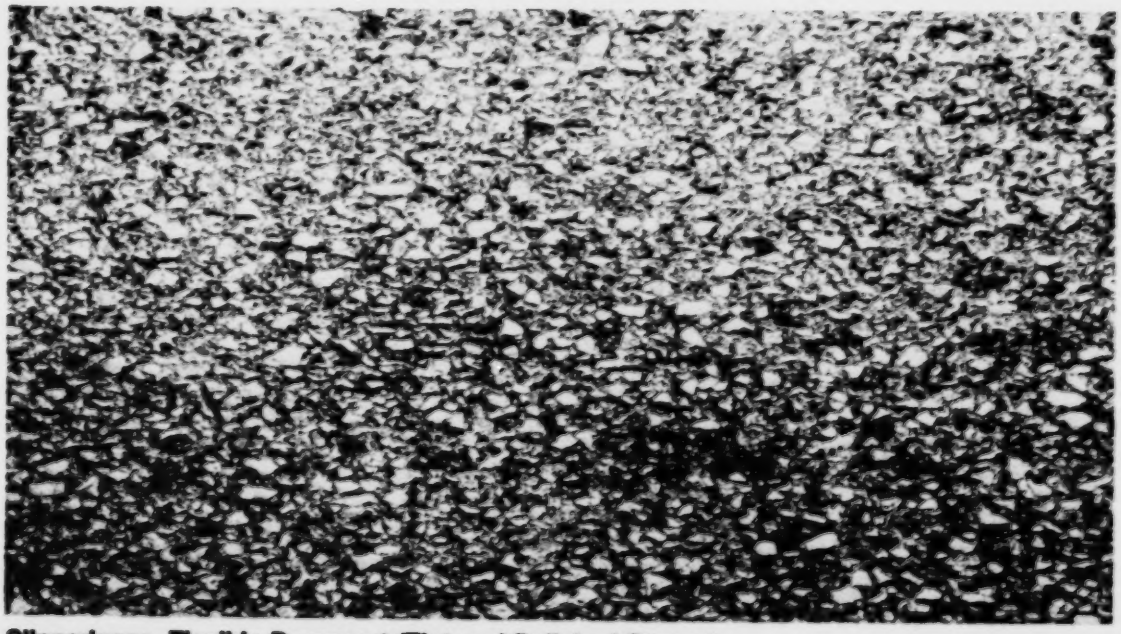
**** Non-routine maintenance task; contract only.

Slippery Surface

Description:	Shining surface from free asphalt; or polished coarse aggregates evident in the pavement surface.
Possible causes:	1. Free asphalt from flushing. 2. Coarse aggregates, which are easily polished under traffic.
Severity:	If slippery pavement surface is suspected, notify or consult District Office immediately.



Slipperiness, Flexible Pavement (Mirror-Polished Surface)



Slipperiness, Flexible Pavement (Flat and Polished Stones)

Treatments for Slippery Surface

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
		If any areas of the pavement surface are suspected of being slippery, notify the District Office immediately of the problem situation, and meanwhile maintain monitoring of the suspected areas.			
		Possible treatments are:			
		Grooving		1090G*	
		Cold Planing (Texturizing)		1090C	
		Hot Mix Patching	1002	1002	4

Note: For Flushing see pages 24 and 25.
* No maintenance performance standard for grooving yet; usually contract only.

Wheel Track Rutting

Description: Longitudinal depression left in the wheel tracks after repeated load application. It results from compaction under load combined with a shoving sideways of pavement material.

Possible causes:

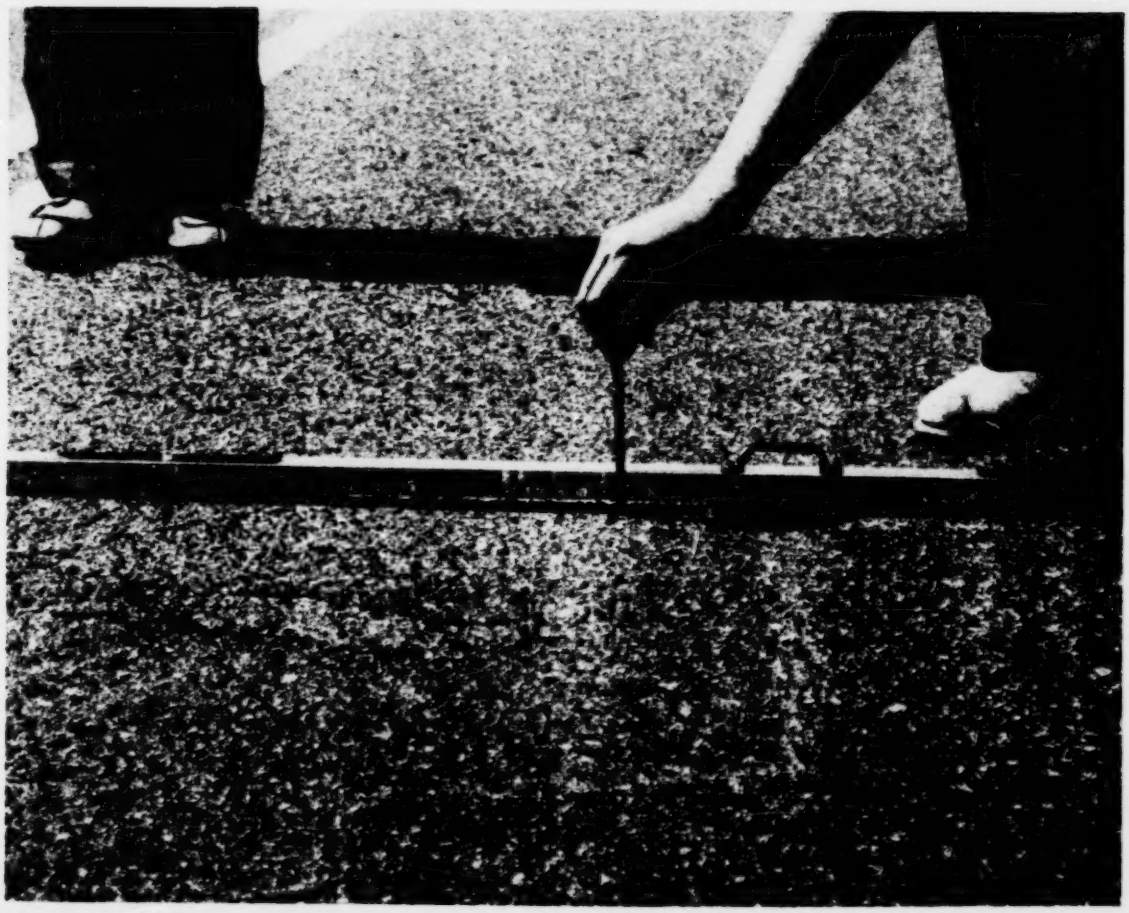
1. Poor construction technique and poor quality control.
2. Poor materials and/or material design.
3. Traffic action.

Severity:

Class.	**Guidelines** (Base on appearance and rut depth measured with a standard 1.2 m gauge width)
Slight	Less than 1 cm
Moderate	Up to 2 cm
Severe	Greater than 2 cm

Density:

Local:	Less than 30% of pavement surface affected; distress spotted over localized areas only.
General:	More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.



Moderate Wheel Track Rutting

Severe Rutting

Treatments for Wheel Track Rutting

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action			
	General	No Action			
Moderate	Local	No Action			
	General	No Action but notify District Office and monitor			
Severe	Local	Hot Mix Patch	1001 1002	1002	3
		Cold Planing		1090C	
		Heater Planing		1090H	
	General	Mulching for highways with AADT < 2000		1014	3
		Granular Lift and Surface Treatment for highways with AADT < 2000		1017	3
		Hot Mix Patch and Single Course Hot Mix Resurfacing for highways with AADT > 2000		1002 ****	6
		Hot Mix Patch only and notify District Office	1001 1002	1002	3

**** Non-routine maintenance task; contract only.

3. Distresses and Maintenance Treatments Rigid Pavement

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Cracking

Description:

Cracks either follow a course approximately parallel to or at right angles to the centreline of the pavement. They can be quite straight or wander like a serpent across the traffic lanes or diagonal to the centreline of the pavement.

Possible causes:

1. Lateral contraction, bending or curling.
2. Fill settlement downward and/or outward.
3. Thermal expansion or contraction.
4. Over-long joint spacing.
5. Insufficient bearing support.
6. Swelling or shrinkage of subsoil.
7. Poor aggregates in concrete mix.
8. Poor joint performance due to improper construction.
9. Pumping through an adjacent transverse joint due to traffic action.
10. Concrete shrinkage.
11. Improper construction procedure.
12. Excessive compressive stresses.
13. Frost action (freeze-thaw).

Severity:

Class.	**Guidelines** (Base on crack width and its condition)
Slight	0.3 cm to 1.3 cm
Moderate	1.3 cm to 2 cm
Severe	2 cm and up (with spalling and stepping developed)

Density:

Local: Less than 30% of pavement surface affected; distress spotted over localized areas only.

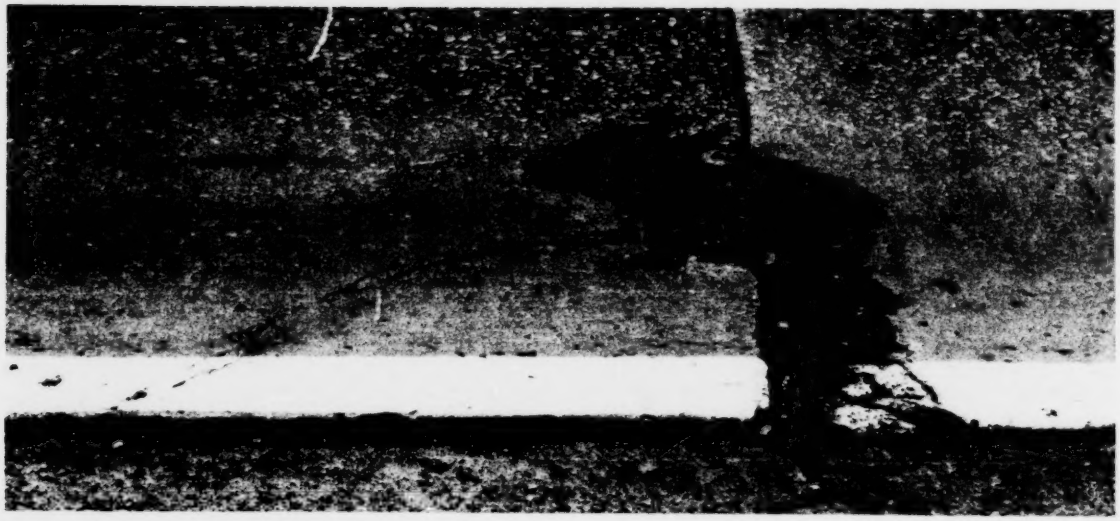
General: More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.

Longitudinal Cracking with Crack Spalling

Meandering Crack (Severe)

Very Severe Transverse Crack with Spalling and Stepping Infiltrated with Debris

Multiple Transverse Cracks Between Joints of Pavement



Severe Corner Crack at Transverse Joint

Treatments for Cracking

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life In Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action			
	General	No Action			
Moderate	Local	No Action			
		Crack Seal with approved materials	1003		1.5
	General	Same as above		1003	1.5
Severe	Local	Same as above	1003		
	General	Same as above	1003	1003	
		Notify District Office	x		

Joint Deficiencies

Joint Failure

Description: Excessive breakdown of slab adjacent to joint so that patching is required to maintain or restore rideability.

Possible causes:

1. High deflections of slab edges at joint under dynamic loads initiates spalls that progress into secondary spalls and then into joint failure. High deflections result from poor slab support and loss of material supporting the slab by pumping.
2. High compressive stresses resulting from creeping slabs; restrained joints and frozen dowels can result in pavement blowup or shattering of the concrete near the joint.
3. Combination of 1. and 2.

Severity: All joint failures are severe: they present a distressing visual effect, a very rough ride, and are inherently dangerous to the travelling public.

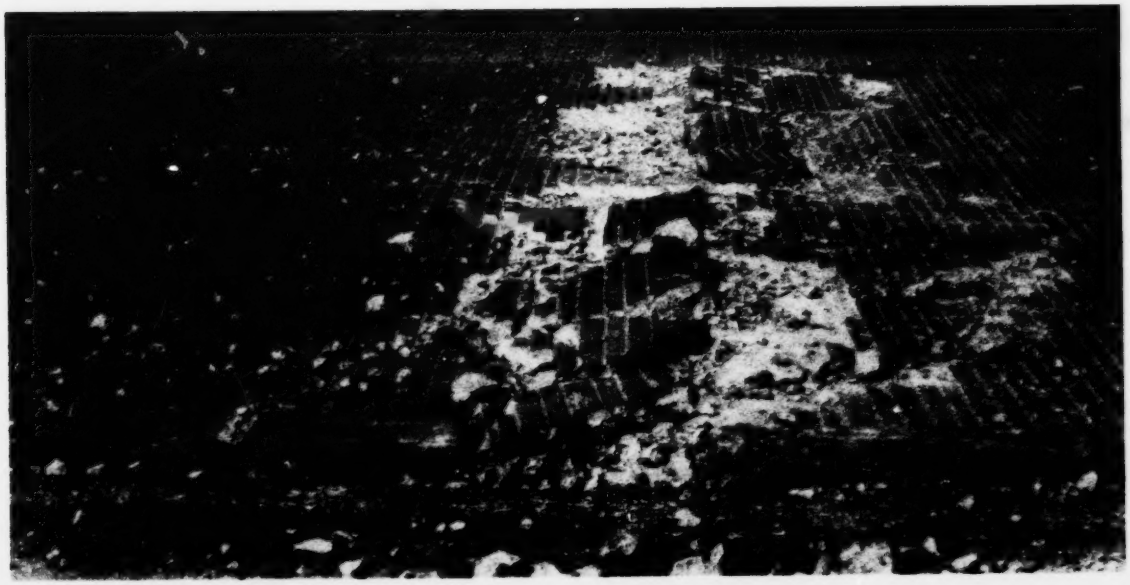
Density:

Local: Less than 30% of pavement surface affected; distress spotted over localized areas only.

General: More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.

Failure from Insufficient Bearing Support

Blowup Failure from Compressive Stresses



Blowup Failure (Shattering) from Compressive Stresses

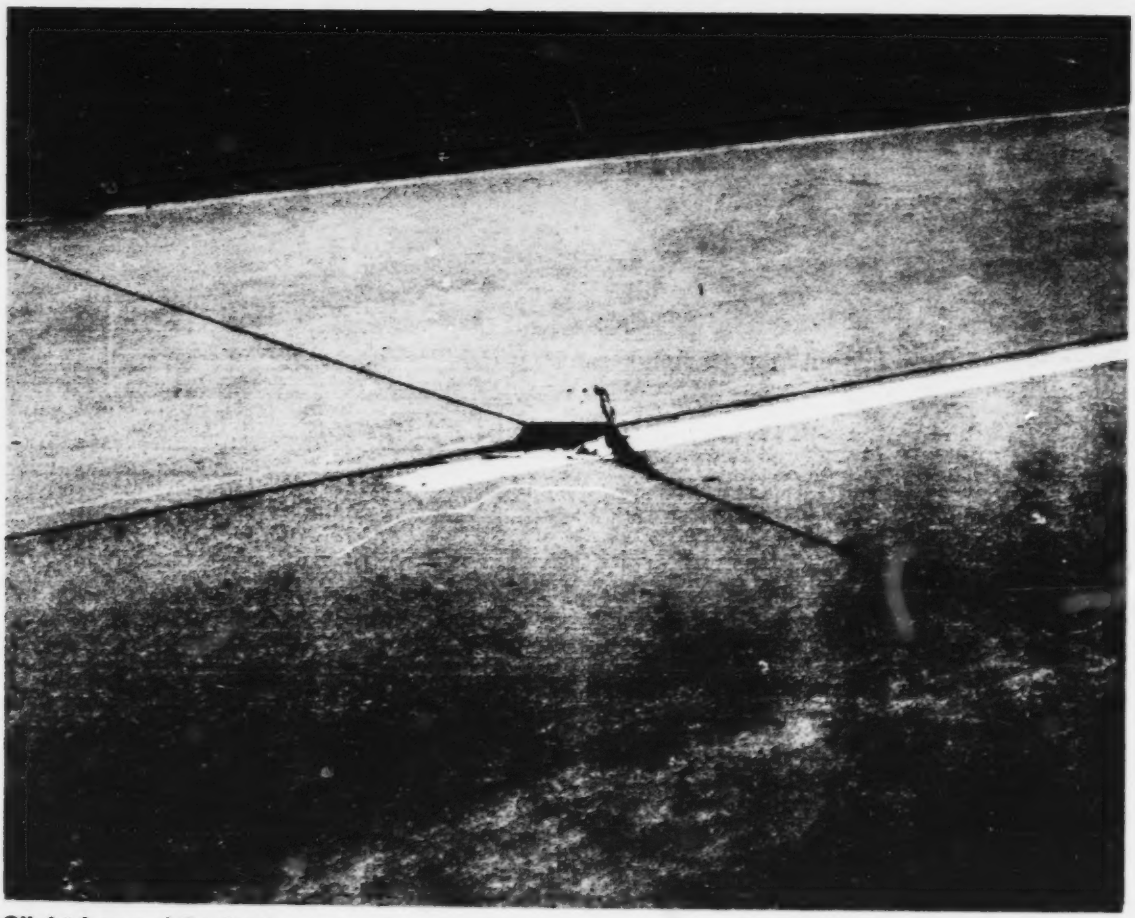
Treatments for Joint Failure

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Only one Class and that is Severe	Local	Excavate, granular and hot-mix patch	1001 1002		3
		Excavate, granular and replace joint with cast-in-place or pre-cast	1090*	1090*	4
	General	Hot Mix Patch and notify District Office immediately	1001 1002	1002	2

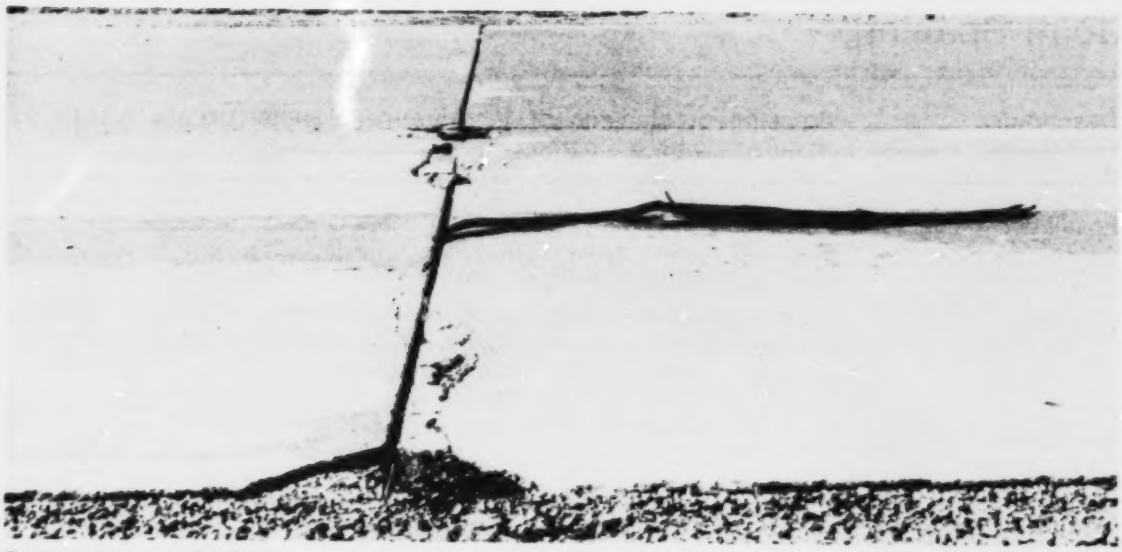
*No maintenance performance standard yet; usually contract.

Joint Sealant Loss

Description:	Transverse or longitudinal joint sealant is being squeezed or pulled out of the joint.	
Possible causes:	1. Traffic action. 2. Expulsion by compressive forces closing the joint too tightly. 3. Deterioration of sealant material.	
Severity:	**Class.**	**Guidelines** (Base on observation)
	Slight	Sealant is broken and beginning to pull out (up to 30 cm)
	Moderate	Sealant is broken and pulled out up to 50% of its length
	Severe	Sealant is broken and pulled out up to 80% of its length
Density:	*Local:*	Less than 30% of pavement surface affected; distress spotted over localized areas only.
	General:	More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.



Slight Loss of Sealant



Severe Loss of Sealant

Treatments for Joint Sealant Loss

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action			
	General	Monitor and notify District Office	x		
Moderate	Local	Reseal with approved sealant	1005		3
	General	Same as above		1005	3
Severe	Local	Same as above	1005		
	General	Same as above		1005	

Joint Spalling

Description: Breaking or chipping of the pavement joints; usually results in fragments with feathered edges.

Possible causes: Spalling of concrete edges is generally due to excessive local pressure caused by a combination of traffic, expansion, warping and curbing; spalling is progressive.

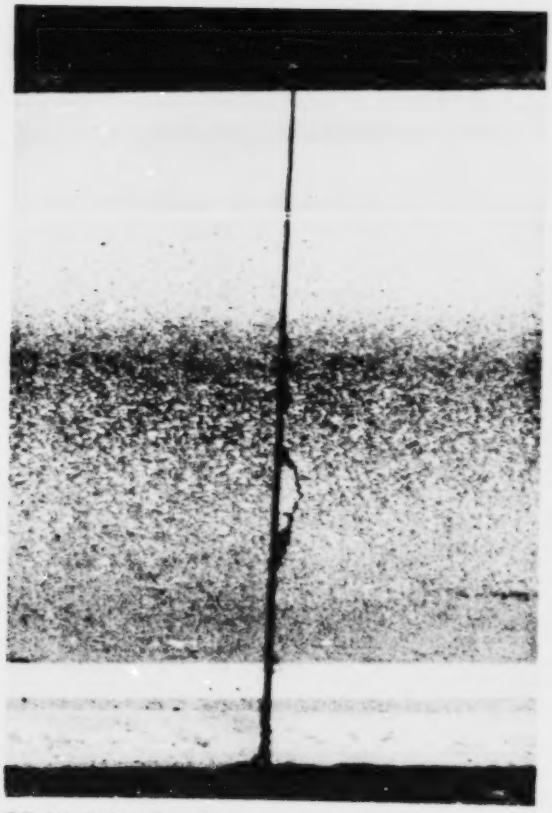
1. Expansive internal pressure due to corrosion of rebar or dowels.
2. Infiltration of debris; movement of slabs is thus prevented by excessive compressive stresses created by thermal expansion.
3. Seized dowel bars combined with thermal expansion.
4. Misalignment of dowel bars and base movement.

Severity:

Class.	**Guidelines** (Base on width, length and depth of spalling)
Slight	Small crack(s) with small pieces broken or missing
Moderate	Cracked with fractures but no large pieces actually missing; some small pieces missing
Severe	Large pieces actually missing at or near wheel paths

Density:

Local:	Less than 30% of pavement surface affected; distress spotted over localized areas only.
General:	More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.



Slight Joint Spalling

Severe Joint Spalling

Treatments for Joint Spalling

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	Notify District Office immediately			
	General	Notify District Office immediately			
Moderate	Local	Clean and Hot Mix Patch if required	1001 1002		2
	General	Clean and Hot Mix Patch where required. Also notify District Office immediately for further consideration	1001 1002	1002	2
		Cutting of full depth stress relief joints		1090V	
Severe	Local	Clean and Hot Mix Patch	1001 1002		2
	General	Clean and Hot Mix Patch and notify District Office	1001 1002	1002	2
		Cutting of full depth stress relief joints		1090V	

Surface Defects

Bump

Description: Sharp local upward displacement of the pavement surface (usually caused by climatic and environmental factors). Generally occurs locally covering an area of about 3 m at most.

Possible causes:

1. Frost heave.
2. Swelling of subgrade materials from moisture changes.

Severity:

Class.	**Guidelines** (Base on observation of distress and effect on rideability)
Slight	Small bumpy effect on vehicle; vehicle still under control. Barely visible bump.
Moderate	Ramp-jumping effect on vehicle; vehicle still under control. Visible hump on pavement surface.
Severe	Ramp-jumping effect on vehicle; vehicle may lose control; large hump on pavement surface.

Density: This type of distress occurs generally in localized areas. Therefore, density is classified as "*Local*" only.

Severe Bump Due to Frost Action

Frost-Related Bump

Severe Bump from Joint Failure

Treatments for Bump

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action but notify District Office if frost-related	x		
Moderate	Local	Cold Mix Patch	1001		0.5
		Hot Mix Patch	1001 1002		2
Severe	Local	Cold Planing	1090C	1090C	
		Cold Mix Patch	1001		0.5
		Hot Mix Patch	1002		2
		Excavate and back-fill with approved granular materials and hot mix patch	1002	1002	4

Potholes

Description: Bowl-shaped holes in pavement surface; can be unrelated to other surface defects, or a direct result of other defects such as ravelling, spalling, etc.

Description:

1. Poor construction technique and poor quality control of construction materials.
2. Frost action and traffic action.
3. Reinforcing steel placed too close to the surface.

Severity:

Class.	**Guidelines** (Base on observation)
Slight	Small hole resembling pop-out of coarse aggregates with disintegration of surrounding material
Moderate	Size of hole much larger and deeper than pop-out of coarse aggregates
Severe	Pothole more than 15 cm wide and usually more than 10 cm deep

---

Density:

Local:	Less than 30% of pavement surface affected; distress spotted over localized areas only.
General:	More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.

Severe Pothole

Moderate Pothole

Slight Pothole

Treatments for Potholes

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action			
	General	Notify District Office			
Moderate	Local	Cold Mix Patch	1001		0.5
		Hot Mix Patch	1001 1002		2
	General	Cold Mix Patch	1001		0.5
		Hot Mix Patch	1001 1002		2
Severe	Local	Cold Mix Patch	1001		0.5
		Hot Mix Patch	1001 1002		1.5
	General	Hot Mix Patch with Singe Course Resurfacing		****	4
		Hot Mix Patch and notify District Office	1002	1002	1.5

**** Non-routine maintenance task; contract only.

Sagging/Settlement

Description: Longitudinal deviation of the pavement surface from its original construction profile; The change in elevation is generally greater than 25 mm, with a wave-length of more than 3 m.

Possible causes:

1. Poorly compacted base of subgrade and/or structure backfill.
2. Differential settlement of subgrade or base materials.
3. Lack of subgrade support.

Severity:

Class.	**Guidelines** (Base on personal experience of the interaction between vehicle and pavement surface distortion)
Slight	Good control of vehicle still present for driver; a slight pitch and roll motion present.
Moderate	Fair control of vehicle when driven over pavement; definite pitch and roll motion.
Severe	Poor control of vehicle when driven over pavement; driver always has to anticipate settlement ahead. Severe pitch and roll motion.

Density:

Local:	Less than 30% of pavement surface affected; distress spotted over localized areas only.
General:	More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.

Settlement Sagging

Differential Settlement

Treatments for Sagging/Settlement

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life In Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action			
	General	No Action but notify District Office	x		
Moderate	Local	No Action but Notify District Office for further consideration	x		
	General	Hot Mix Patch selected areas and notify District Office	1001 1002	1002	2
Severe	Local	Mud-Jacking		1090M	
		Hot Mix Patch	1001 1002	1002	2
	General	Hot Mix Patch selected areas and notify District Office	1001 1002	1002	2

Scaling/Ravelling

Description: Peeling away of the concrete pavement surface and loss of fine aggregates from matrix; may occur anywhere over the pavement surface.

Possible causes:

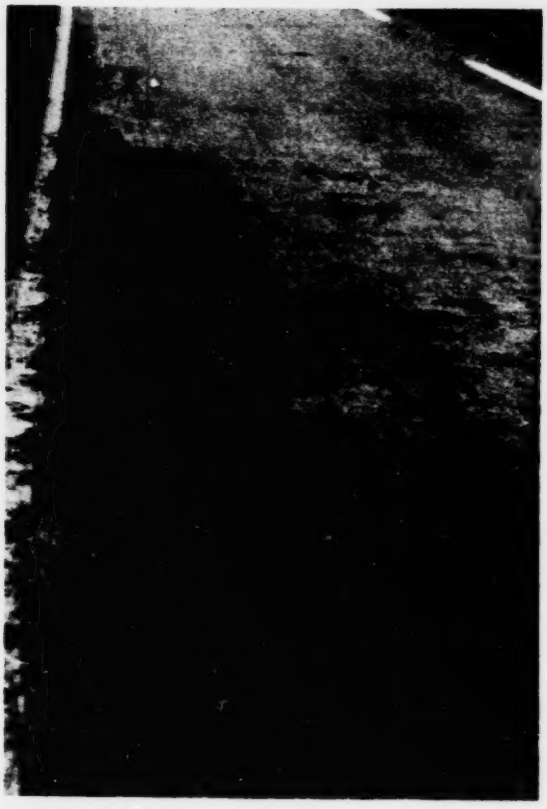
1. Effect of freeze-thaw and/or de-icing chemicals on non air-entrained concrete.
2. Frost action.
3. Poor construction technique and poor quality control.

Severity:

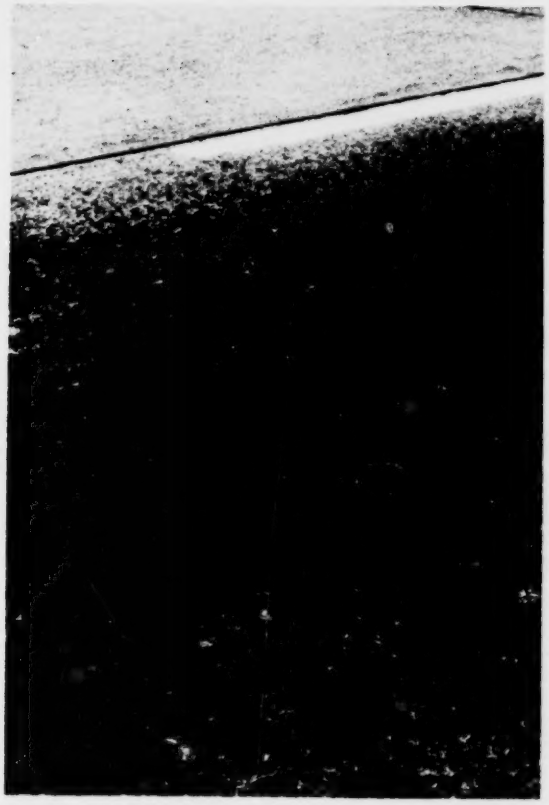
Class.	**Guidelines** (Base on observation)
Slight	Very shallow flecking or peeling in small patches
Moderate	Shallow patches with open texture from peeling or flecking
Severe	Disintegration in shallow patches closely spaced; small shallow potholes

Density:

Local:	Less than 30% of pavement surface affected; distress spotted over localized areas only.
General:	More than 30% of pavement surface affected: distress spotted evenly over entire length of pavement section.



Severe Scaling



Moderate Ravelling

Severe Ravelling

Treatments for Scaling/Ravelling

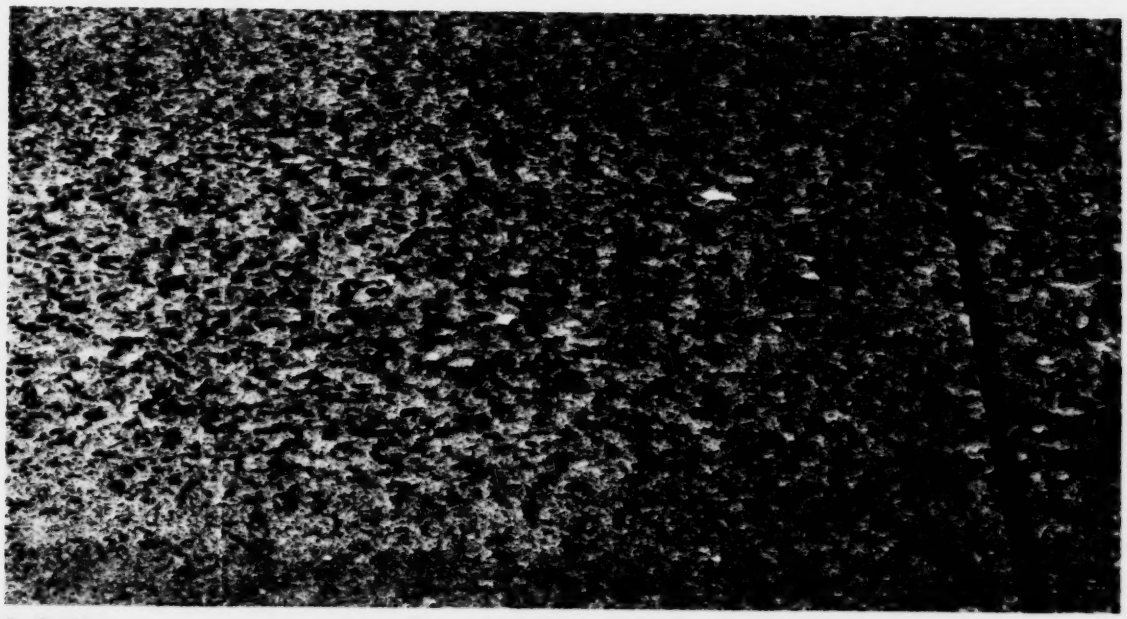
Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action			
	General	No Action			
Moderate	Local	No Action			
	General	No Action; Notify District Office			
Severe	Local	Hot Mix Patch	1001 1002		4
	General	Hot Mix Patch and notify District Office		1002	4

Slippery Surface

Description Pavement surface appears polished and glossy.

Possible causes: Traffic action on coarse aggregates, which are easily polished by traffic.

Severity: If slippery pavement surface is suspected, notify or consult District Office immediately. Maintain monitoring of suspected areas.



Polishing

Treatments for Slippery Surface

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
		If any area of the pavement surface is suspected of being slippery, notify the District Office immediately of the problem situation, and maintain monitoring of the suspected areas. Possible treatments are:			
		Grooving		1090G*	
		Cold Planing		1090C	
		Hot Mix Patch		1002	5

*No maintenance performance standard for grooving yet; usually contract work.

Stepping (Faulting)

Description: Differential vertical displacement of abutting slabs at joints or cracks creating a "step" deformation in the pavement surface. Usually the "upstream" slab is higher than the "downstream" slab.

Possible causes:

1. Pumping of slabs.
2. Lack of subgrade support.
3. Frost action.

Severity:

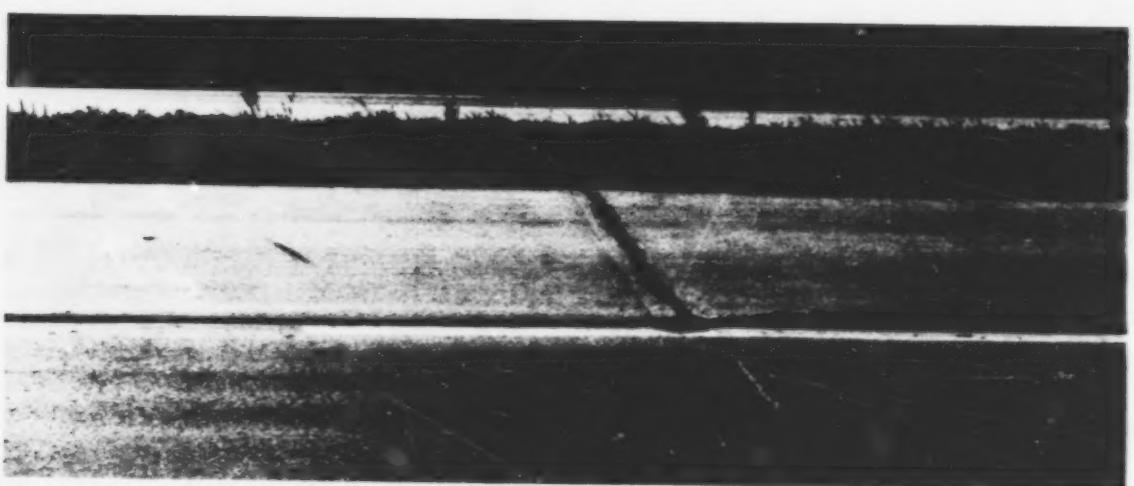
Class.	**Guidelines** (Base on height of stepping)
Slight	O.3 to 0.7 cm range
Moderate	0.7 to 1.3 cm range
Severe	Greater than 1.3 cm

Density:

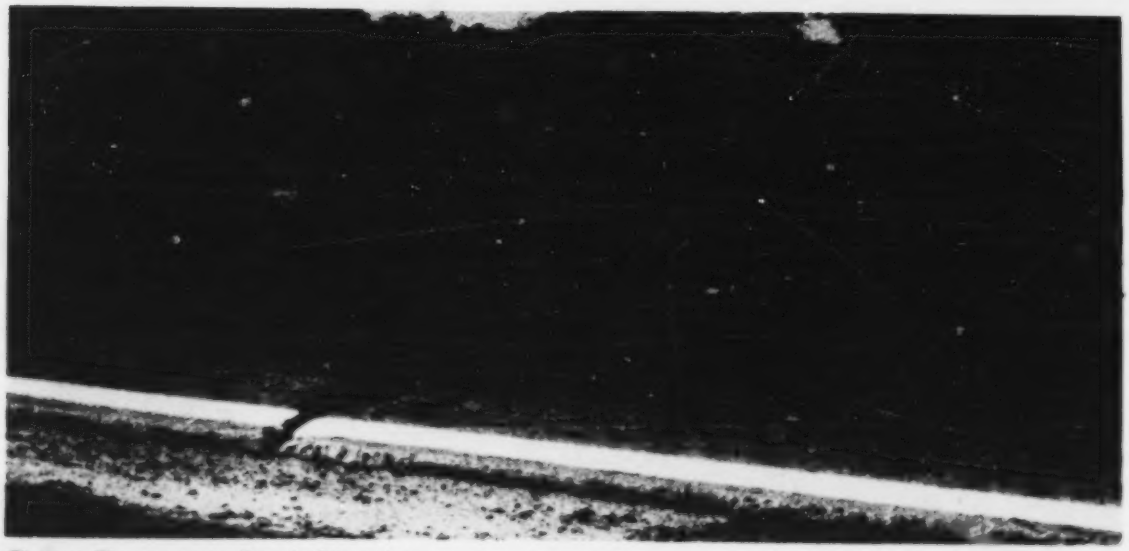
Local: Less than 30% of pavement surface affected; distress spotted over localized areas only.

General: More than 30% of pavement surface affected; distress spotted evenly over entire length of pavement section.

Severe Transverse Joint Stepping



Moderate Longitudinal Joint Stepping



Severe Transverse Crack Stepping

Treatments for Stepping (Faulting)

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	*Density*		*Routine patrol*	*Non-patrol*	
Slight	Local	No Action			
	General	No Action but notify District Office for consideration of subdrains		*	
Moderate	Local	Reseal joint and crack (rout if necessary) where stepping occurs	1005		
	General	Reseal joint and crack (rout if necessary) where stepping occurs plus installation of subdrains		1005	
		Notify District Office for investigative action		*	
Severe	Local	Mud-Jacking to restore slab supports and reseal joint or crack where stepping occurs		1090M	
	General	Hot Mix Patch and installation of subdrains	1001 1002	1002	3
		Hot Mix Patch selected areas and notify District Office for further consideration	*	1002	4

*Contract only.

4. Distresses–Shoulder and Surface Drainage

Encroaching Growth	60
Erosion/Washout	61
Excessive Shoulder Slope Drop-off	62
Pavement Edge Drop-off/Excessive Height	63
Pavement/Shoulder Surface Drainage	64
Potholes/Cracking (Stabilized or Paved Shoulders)	66

Introduction

Distresses of the shoulder and of surface drainage greatly influence the performance and service life of a pavement.

Pavement shoulder distresses, particularly those of gravel shoulders, are important because they can be hazardous to the travelling public. Some of these distresses are also detrimental to the pavement's performance and service life, causing it to fail for example, by not providing adequate lateral support.

Surface drainage distresses can also become hazardous; for example, ponding of water on the pavement surface creates conditions ideal for hydro-planing—a very dangerous phenomenon. In addition, it is well known how detrimental improperly drained surface water can be to the pavement's performance and service life.

These distresses are pictorially presented in this chapter simply as a reminder of their importance. Details on maintenance procedures and quality standards are presented in the publication "Quality Standards."

Encroaching Growth

Description: Vegetation growth overruns shoulder and reaches or approaches close to the pavement edge.

Possible causes:
1. Shoulders are too narrow.
2. Improper maintenance practice.

Severe Encroaching Growth

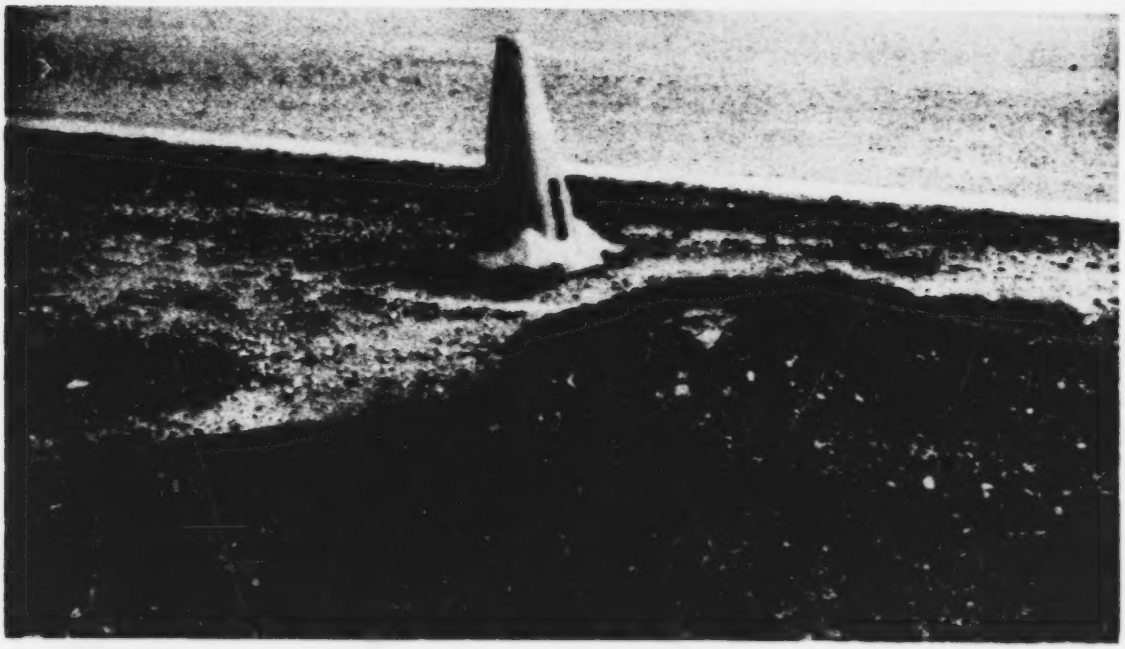
Erosion/Washout

Description: Massive loss of the shoulder's granular materials at or near the pavement edge.

Possible causes:

1. Improper surface drainage design.
2. Improper maintenance practice.
3. Environmental calamities such as flooding, etc.

Improper Surface Drainage System



Severe Washout

Excessive Shoulder Slope Drop-off

Description: The shoulder has lost its proper crown. The excessive drop-off may occur along the entire shoulder or as an abrupt drop-off anywhere in the cross section of the shoulder.

Possible causes:

1. Traffic action.
2. Unstable materials.
3. Unstable base or subgrade.
4. Improper maintenance.

Moderate Shoulder Slope Drop-off

Severe Shoulder Slope Drop-off

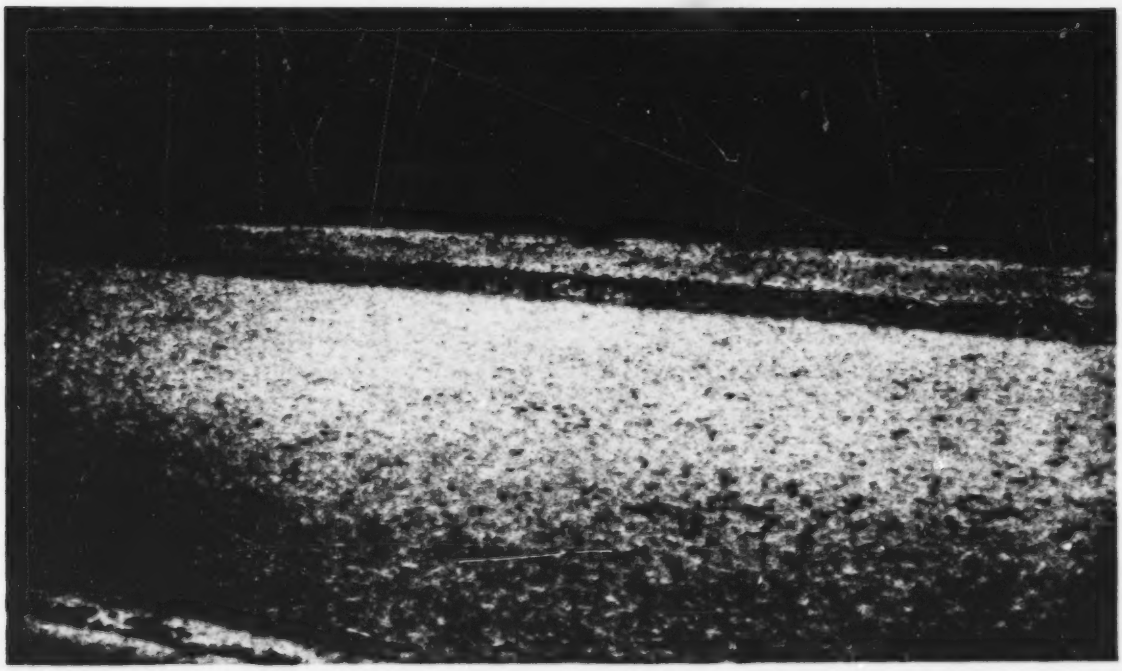
Pavement Edge Drop-off/Excessive Height

Description: Shoulder's granular materials are being pushed or removed from the pavement edge, creating a vertical drop-off; or granular materials are being windrowed into a ridge adjacent to the pavement that is higher than the pavement itself.

Possible causes:

1. Traffic action.
2. Unstable granular materials used for the shoulder.
3. Improper maintenance.

Pavement Edge Drop-off



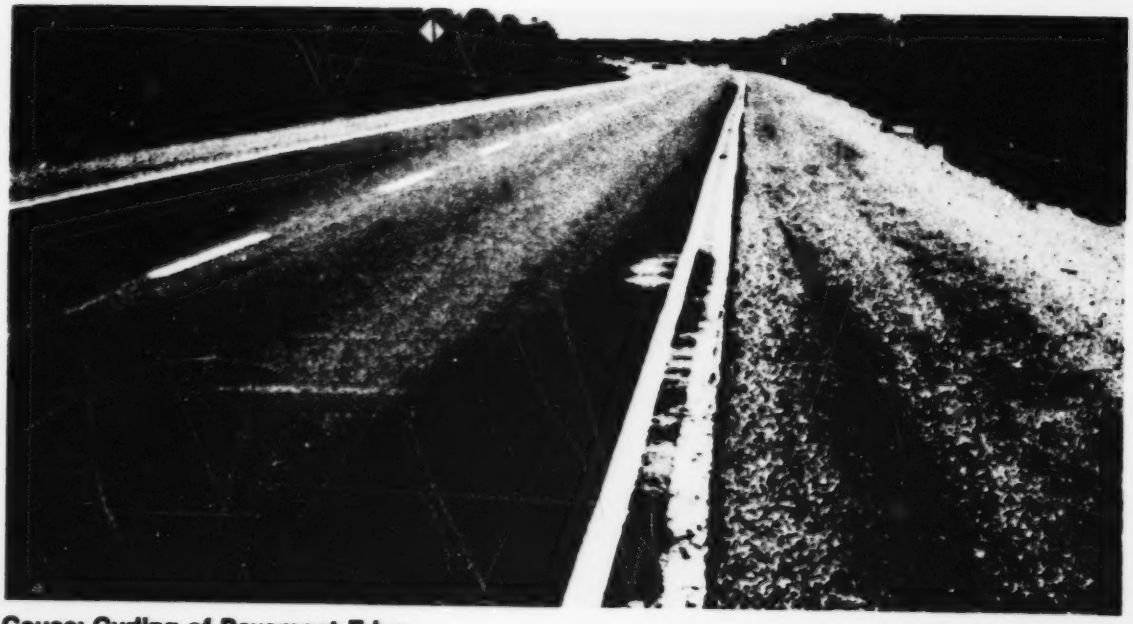
Excessive Height of Shoulder

Pavement/Shoulder Surface Drainage

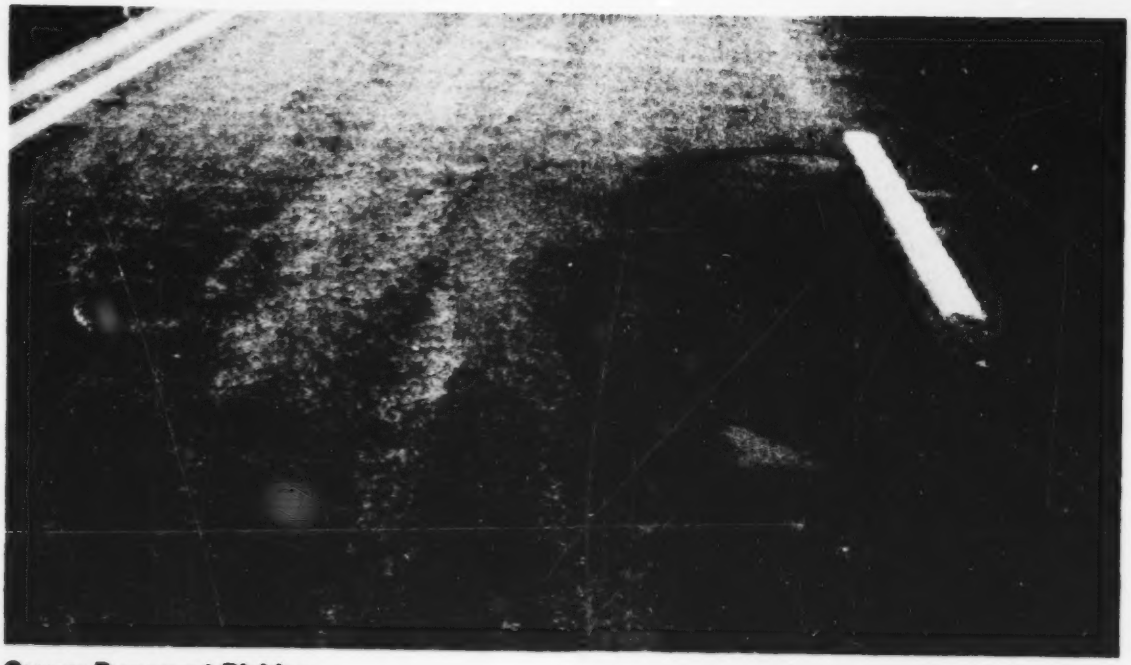
Description: Free standing water trapped or unable to drain freely and properly from the pavement surface or shoulder surface.

Possible causes:

1. Pavement surface rutting and distortions.
2. Curling of pavement edge.
3. Pavement edge drop-off or excessive shoulder height.
4. Excessive shoulder slope drop-off.
5. Excessive growth or vegetation at shoulder.
6. Improper surface drainage design.
7. Improper maintenance practice.



Cause: Curling of Pavement Edge



Cause: Pavement Dishing

Cause: Pavement Edge Drop-off

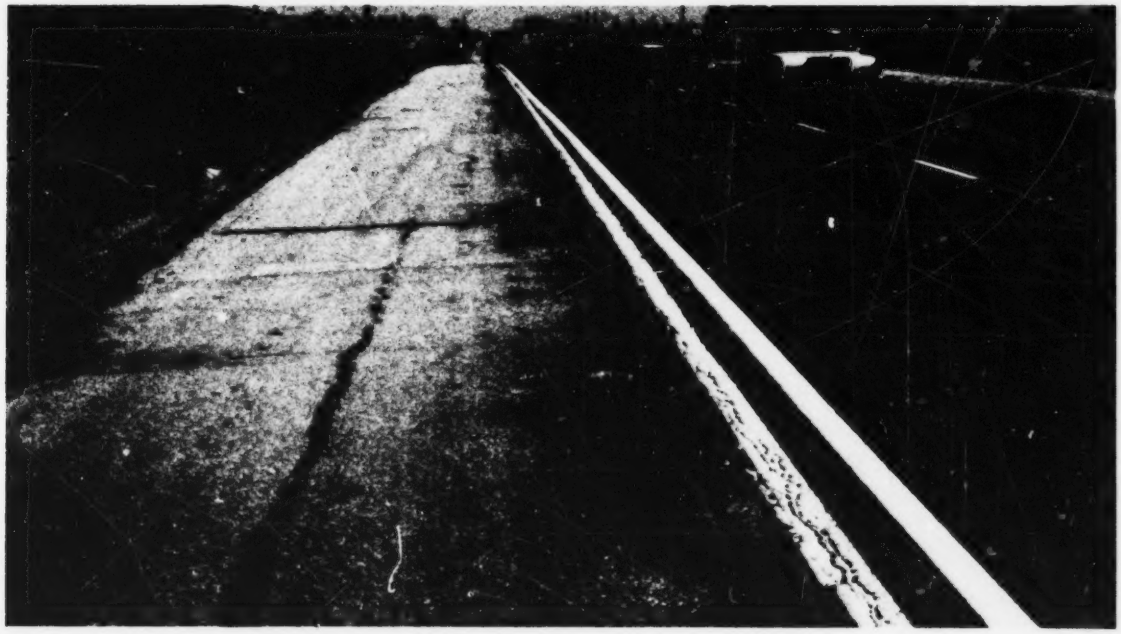
Cause: Improper Surface Drainage Design

Cause: Improper Maintenance Practice

Potholes/Cracking (Stabilized or Paved Shoulders)

Description: These distresses occur in stabilized or paved shoulders in the same way as in pavements of similar type. Therefore, the same descriptions are applicable.

Possible causes: After-effects of differential heaving, settlement.



Multiple Cracking on Paved Shoulder

Pothole on Paved Shoulder

5. Performance Standards for Maintenance Treatments

Flexible Pavement		
Burn (and Seal) Asphalt Pavement	M-1090B	108
Cold Planing	M-1090C	102
Crack Sealing	M-1003	86
Grooving**	M-1090G	
Heater Planing	M-1090H	104
Machine Patching — Placing and Spreading Hot or Cold Mix Asphalt	M-1002	82
Manual Patching — Placing and Spreading Hot or Cold Mix Asphalt	M-1001	68
Manual Patching — Placing and Spreading Recycled Hot Mix Asphalt	M-1001*	72
Mulch Pavement — Mixed in Place	M-1014	94
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Rigid Pavement		
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Crack Sealing	M-1003	86
Cut Full Depth Stress Relief Joints	M-1090V	115
Grooving**	M-1090G	
Joint Sealing	M-1005	110
Machine Patching — Placing and Spreading Hot or Cold Mix Asphalt	M-1002	82
Manual Patching — Placing and Spreading Hot or Cold Mix Asphalt	M-1001A*	76
Mud Jacking	M-1090M	112

**No performance standards for Grooving as yet; contract only.

Introduction

The Maintenance Performance Standard charts in this chapter will assist you in estimating the costs of various maintenance treatment alternatives. Recommended step-by-step maintenance procedures are also included.

Each chart describes the maintenance treatment required for particular road types and details the manpower, equipment and materials needed for the job, and how much can be accomplished in one day's work.

First, estimate the costs for each of those items; then you can calculate the *unit cost* for each treatment alternative.

$$\frac{\text{MANPOWER + EQUIPMENT + MATERIALS}}{\text{ACCOMPLISHMENT PER DAY}} = \text{UNIT COST}$$

Having completed that calculation, check back to the distress treatment table where the expected service life of the recommended treatment is listed. Now, calculate the *equivalent annual cost.*

$$\frac{\text{UNIT COST}}{\text{EXPECTED LIFE OF ALTERNATIVE}} = \text{EQUIVALENT ANNUAL COST}$$

For complete "how-to's" on calculating unit cost and equivalent annual cost, see Chapter 1, page 2).

A comparison of the equivalent annual costs for each treatment alternative will indicate the one with the lowest cost; this is usually the most cost-effective and should be carried out unless other factors prevail (See Chapter 1).

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MAINTENANCE PERFORMANCE STANDARD page of

M-1001 (Flexible Pavement)

Manual Patching — Placing and Spreading Hot or Cold Mix Asphalt

DESCRIPTION

The manual placing and spreading of premixed asphaltic materials (hot or cold mix) to repair potholes, minor depressions, bumps, frost heaves and other pavement defects. Includes preparation of patching area and compaction.

ROAD TYPE			
HOT MIX MULTI-LANE	HOT MIX 2-3 LANE	MULCH 2-LANE	PRIME AND SURFACE TREATED 2-LANE
CREW SIZE			
1-Driver 2-Shovellers/ Rakers 1 to 2-Drivers (for Traffic Control)	1-Driver 2-Shovellers/ Rakers 1 to 3-Flagmen (for Traffic Control)	1-Driver 2-Shovellers/ Rakers 1 to 3-Flagmen (for (Traffic Control)	1-Driver 2-Shovellers/ Rakers 1 to 3-Flagmen (for Traffic Control)
EQUIPMENT			
1-Dump Truck 1-Portable Roller or Hand Tamp 1 or 2-sign trucks or sign trailers	1-Crew Carrier 1-Dump Truck 1-Portable Roller or Hand Tamp	1-Crew Carrier 1-Dump Truck 1-Portable Roller or Hand Tamp	1-Crew Carrier 1-Dump Truck 1-Portable Roller or Hand Tamp
MATERIALS			
Hot or Cold Mix	Hot or Cold Mix	Cold Mix	Cold Mix
ACCOMPLISHMENT			
Tonnes	Tonnes	Tonnes	Tonnes
MANHOURS PER ACCOMPLISHMENT			
5.7 - 10.0	4.0 - 8.0	5.0 - 5.7	4.5 - 5.3
ACCOMPLISHMENT PER DAY			
7.0 - 4.0	10.0 - 4.0	8.0 - 7.0	9.0 - 7.5

Recommended Method

1. Set up safety devices and signs in accordance with "Traffic Control Manual for Highway Work Operations."

2. a. **Hot Mix and Mulch Surfaces:** Remove all loose material, trim sides of patch area straight down. Sweep up debris, sweep out water.

   b. **Prime and Surface Treated:** Remove all loose material, sweep up debris, sweep out water.

3. Apply a tack coat to provide a bond between the existing pavement and the patch material.

4. Shovel the mix into the patch area in lifts of not more than 8 cm against the sides and then toward the centre. Feather out the mix around the edges of the patch.

5. Place additional layers of mix 8 cm in thickness to bring the patch up to the level of the surrounding pavement.

6. Compact the mix with a portable roller, hand tamper or truck wheels.

Procedures for Placing and Spreading Hot or Cold Mix Asphalt (Manual Patching)

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M-1001* (Flexible Pavement)

Manual Patching — Placing and Spreading Recycled Hot Mix Asphalt

DESCRIPTION

The manual placing and spreading of re-cycled asphaltic materials to repair potholes, minor depressions, bumps, frost heaves and other pavement defects. Includes preparation of patching area and compaction.

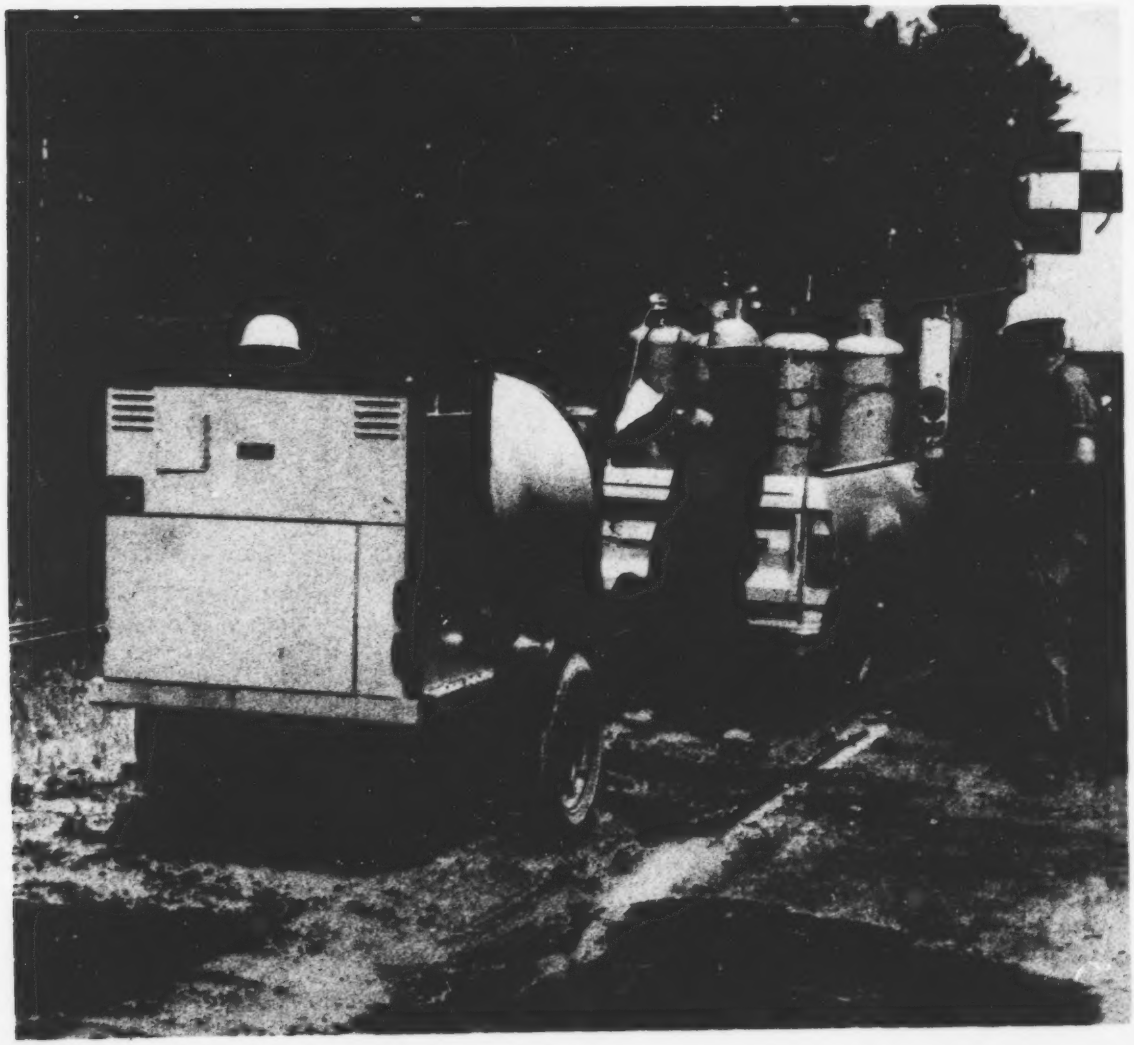
ROAD TYPE HOT MIX MULTI-LANE	HOT MIX 2-3 LANE	MULCH 2-LANE
CREW SIZE 1-Driver 2-Shovellers/ Rakers 1 to 2-Drivers (for Traffic Control)	1-Driver 2-Shovellers/ Rakers 1 to 3-Flagmen (for Traffic Control)	1-Driver 2-Shovellers/ Rakers 1 to 3-Flagmen (for Traffic Control)
EQUIPMENT 1-Crew Carrier 1-Dump Truck 1-Portable Roller 1-Recycler 1 or 2-sign trucks or sign trailers	1-Crew Carrier 1-Dump Truck 1-Portable Roller 1-Recycler	1-Crew Carrier 1-Dump Truck 1-Portable Roller 1-Recycler 1-Crew Carrier 1-Dump Truck 1-Portable Roller 1-Recycler
MATERIALS Propane, Reclaimed Asphalt	Propane, Reclaimed Asphalt	Propane, Reclaimed Asphalt
ACCOMPLISHMENT Tonnes	Tonnes	Tonnes
MANHOURS PER ACCOMPLISHMENT 3 - 6	3 - 6	3 - 6
ACCOMPLISHMENT PER DAY 13.3 - 6.7	13.3 - 6.7	13.3 - 6.7

Recommended Method

1. Set up safety devices and signs in accordance with "Traffic Control Manual for Highway Work Operations".
2. a. **Hot Mix and Mulch Surfaces:** Remove all loose material, trim sides of patch area straight down. Sweep up debris, sweep out water.

   b. **Prime and Surface-Treated:** Remove all loose material, sweep up debris, sweep out water.
3. Apply a tack coat to provide a bond between the existing pavement and the patch material.
4. Shovel the mix into the patch area in lifts of not more than 8 cm against the sides and then toward the centre. Feather out the mix around the edges of the patch.
5. Place additional layers of mix 8 cm in thickness to bring the patch up to the level of the surrounding pavement.
6. Compact the mix with a portable roller, hand tamper or truck wheels.

Procedures for Placing and Spreading *Recycled* Hot Mix Asphalt (Manual Patching)



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MAINTENANCE PERFORMANCE STANDARD page of

M-1001A* (Rigid Pavement)

Manual Patching — Placing and Spreading Hot or Cold Mix Asphalt

DESCRIPTION

The manual placing and spreading of premixed asphaltic materials (hot or cold mix) to repair potholes, minor depressions, bumps, frost heaves and other pavement defects. Includes preparation of patching area and compaction.

*For use where existing concrete must be removed prior to placing patch.

ROAD TYPE

MULTI-LANE
CONCRETE

CREW SIZE

1-Foreman
3-Drivers
1-Loader Opr.
1-Saw/Roller Opr.
2-Jackhammer Oprs.
2-Shovellers

1 to 2-Drivers
(Traffic Cont.)

EQUIPMENT

1-Crew Carrier
3-Dump Trucks
1-Loader
1-Concrete Saw
1-Compressor
2-Jackhammers
1-Portable Roller
1-Cutting Torch
1-Plate Vibrator

1 or 2-Sign Trucks/
Sign Trailers

MATERIALS

Hot Mix

ACCOMPLISHMENT

Tonnes

MANHOURS PER ACCOMPLISHMENT

9.6 - 24

ACCOMPLISHMENT PER DAY

10 - 4

Recommended Method

1. Set up safety devices and signs in accordance with "Traffic Control Manual for Highway Work Operations".
2. Remove broken sections of existing concrete by sawing and jack hammering.
3. Clean out loose material from patch area by blowing and brushing.
4. Apply a tack coat to provide a bond between the existing pavement and the patch material.
5. Shovel the mix into the patch area in lifts of not more than 8 cm against the sides and then toward the centre. Feather out the mix around the edges of the patch.
6. Place additional layers of mix 8 cm in thickness to bring the patch up to the level of the surrounding pavement.
7. Compact the mix with a portable roller, hand tamper or truck wheels.

Procedures for Placing and Spreading Hot or Cold Mix Asphalt (Manual Patching) — See page 79.

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Communications

MAINTENANCE PERFORMANCE STANDARD page of

M-1001B (Rigid Pavement)

Concrete Pavement Repairs with Recycled Hot Mix Asphalt

DESCRIPTION

Repairs to Potholes, Sagging/Settlement, Bumps, Joint Spalling, Joint Failures Etc., where the repair is done with re-cycled hot mix asphalt.

ROAD TYPE

MULTI-LANE
CONCRETE

CREW SIZE

1-Foreman
1-Concrete Saw Opr.
1-Operator/Helper
2-Jackhammer Opr.
1-Loader/Comp. Air Opr.
1-Recycler Opr.
1-Roller Opr./Helper

EQUIPMENT

1-1/2 Ton
*1-5 T Dump/W Water Tank
*1-Conc. Saw
*1-Trailer/Small Fixed Bed
1-Air Comp.
2-Jackhammers
1-Loader
1-Tri-Axle Trailer
1-1/2 Ton
1-Roller
1-5 T Dump
1-Trailer/Small Tilt Bed
1-Recycler
1-5 T Sign Truck
1-Sign Trailer

* Note: Generally these units will not be required on a full time basis.

MATERIALS

Propane And Re-cycled
Hot Mix Aspahlt

ACCOMPLISHMENT

Tonnes Used

MANHOURS PER ACCOMPLISHMENT

16 - 10.67

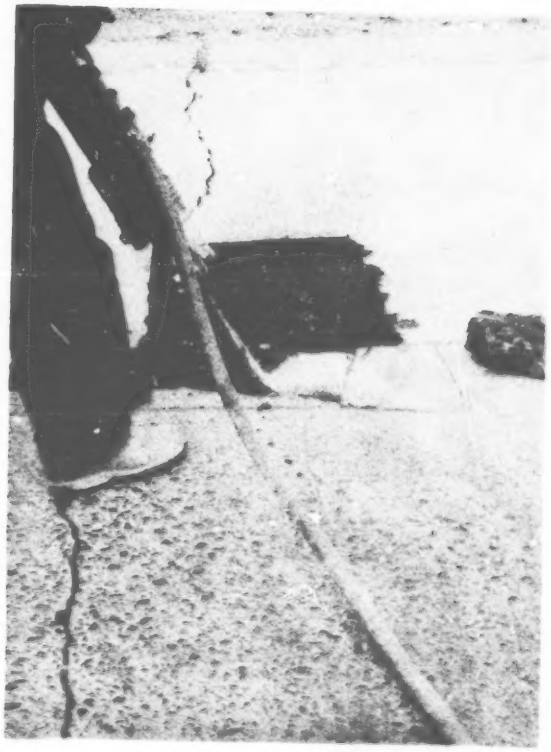
ACCOMPLISHMENT PER DAY

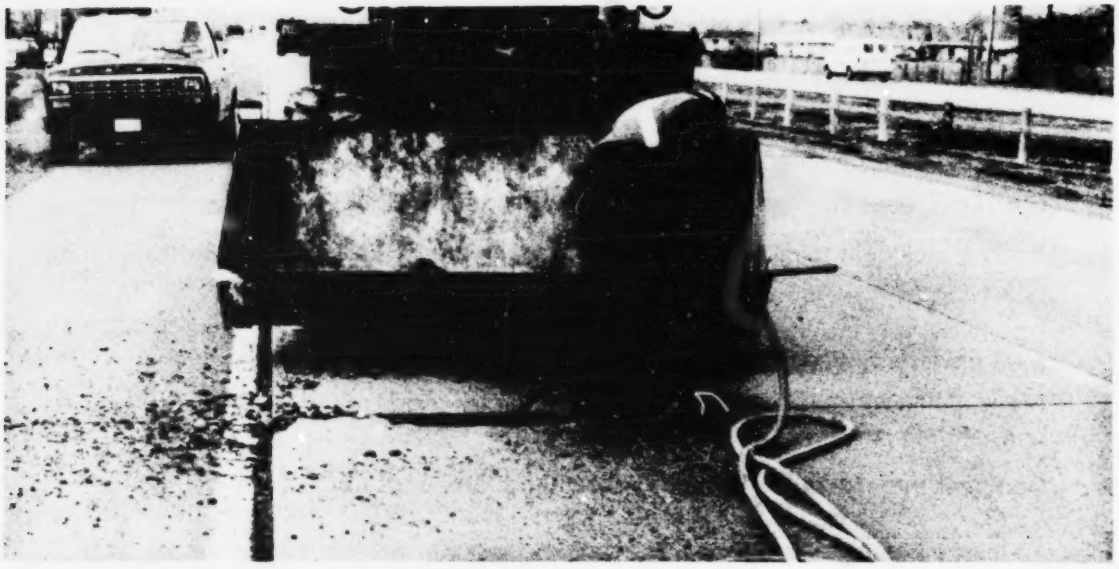
4 - 6

Recommended Method

1. Set up safety devices and signs in accordance with "Traffic Control Manual for Highway Work Operations."
2. Remove broken sections of existing concrete by sawing and jack hammering.
3. Clean out loose material from patch area by blowing and brushing.
4. Apply a tack coat to proved a bond between the existing pavement and the patch material.
5. Shovel the mix into the patch area in lifts of not more than 8 cm against the sides and then towards the centre. Feather out the mix around the edges of the patch.
6. Place additional layers of mix 8 cm in thickness to bring the patch up to the level of the surrounding pavement.
7. Compact the mix with a portable roller, hand tamper or truck wheels.

Procedures for Concrete Pavement Repairs with (1) Hot or Cold Mix Asphalt and (2) *Recycled* Hot Mix Asphalt





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MAINTENANCE PERFORMANCE STANDARD page of

M-1002

MACHINE PATCHING PLACING AND SPREADING

DESCRIPTION

The machine placing and spreading of premixed asphaltic materials (hot or cold mix) to repair major surface defects such as depressions, bumps and other pavement defects. Includes preparation of patching area and compaction.

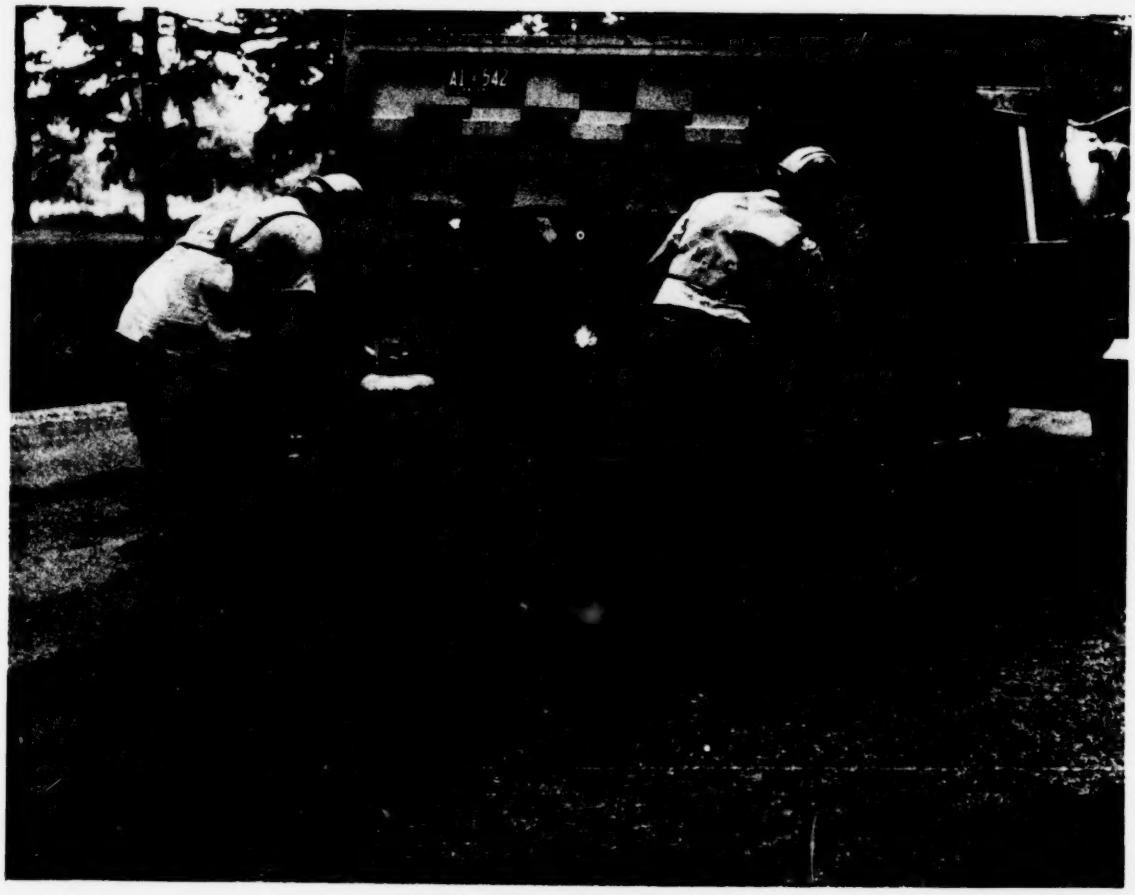
ROAD TYPE	HOT MIX 2-3 LANE	MULCH 2-LANE	ALTERNATIVE METHOD FOR ALL ROAD TYPES
HOT MIX MULTI-LANE			
CREW SIZE			
1-Grader Opr. 1-Roller Opr. 2-Shovellers/Rakers 1 to 5-Drivers (Asphalt Supply) 1 to 2-Drivers (Traffic Cont.)	1-Grader Opr. 1-Roller Opr. 2-Shovellers/Rakers 1 to 5-Drivers (Asphalt Supply) 1 to 3-Flagmen (Traffic Cont.)	1-Grader Opr. 1-Roller Opr. 2-Shovellers/Rakers 1 to 5-Drivers (Asphalt Supply) 1 to 3-Flagmen (Traffic Cont.)	2-Screed Oprs. 1-Roller Opr. 2-Shovellers/Rakers 1 to 5-Drivers (Asphalt Supply) 1 to 2-Drivers or 1 to 3-Flagmen (Traffic Cont.)
EQUIPMENT			
1-Crew Carrier 1-Grader 1-Roller 1 to 5-Dump Trucks 1 or 2-Sign Trucks or Sign Trailers	1-Crew Carrier 1-Grader 1-Roller 1 to 5-Dump Trucks	1-Crew Carrier 1-Grader 1-Roller 1 to 5-Dump Trucks	1-Crew Carrier 1-Tailgate Spreader 1-Roller 1 to 5 Dump Trucks 1 to 2 Sign Trucks/ Sign Trailers
MATERIALS			
Hot or Cold Mix	Hot or Cold Mix	Cold Mix	Hot Mix
ACCOMPLISHMENT			
Tonnes	Tonnes	Tonnes	Tonnes
MANHOURS PER ACCOMPLISHMENT			
0.7 - 2	0.7 - 2	0.7 - 2	
ACCOMPLISHMENT PER DAY			
105 - 35	105 - 35	105 - 35	

Recommended Method

1. Set up safety devices and signs in accordance with "Traffic Control Manual for Highway Work Operations."
2. Remove any loose or broken sections of existing pavement extending into the good pavement about 30 cm. Clean up the patch area, removing all loose material and water.
3. Compact the subgrade, if necessary.
4. Apply a tack coat at each end of the patch and along the centreline joint when one lane is to be patched.
5. Place and spread the mix with a grader or a tailgate spreader.
6. Smooth and feather out the edges of the patch.
7. Be sure that enough mix material has been placed to obtain the proper grade and cross-fall.
8. Compact the patch area, rolling progressively from the high side toward the low side, overlapping a few centimetres on each pass.

   Note: Joints at the ends of the patch should be spray patched at a later date.

Procedures for Placing and Spreading Hot or Cold Mix Asphalt (Machine Patching)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MAINTENANCE PERFORMANCE STANDARD page of

M-1003
Crack Sealing

DESCRIPTION

The preparation and filling of cracks with emulsified asphalt or rubberized asphalt, and followed by the spreading of stone chips or sand when required. Includes minor spray patching of distressed areas when performed during crack filling operations.

ROAD TYPE	HOT MIX CONCRETE MULTI-LANE		HOT MIX CONCRETE 2-LANE	
CREW SIZE	(or)		(or)	
	2-Drivers 1-Sweeper 2-Router/Comp. Air Oprs. 1-Spray Bar Opr. or 2-Pourers 1 to 2-Drivers (Traffic Control)	2-Drivers 1-Sweeper 2-Router/Comp. Air Oprs. 1-Spray Bar Opr. or 2-Pourers 1 to 2-Drivers (Traffic Control)	2-Drivers 1-Sweeper 2-Router/Comp. Air Oprs. 1-Spray Bar Opr. or 2-Pourers 1 to 3-Flagmen (Traffic Control)	2-Drivers 1-Sweeper 2-Router/Comp. Air Oprs. 1-Spray Bar Opr. or 2-Pourers 1 to 3-Flagmen (Traffic Control)
EQUIPMENT	1-Crew Carrier 1-Dump Truck 1-Mtce. Kettle 1-Air Comp. 1 or 2-Sign Trucks/ Sign Trailers	1-Crew Carrier 1-Dump Truck 1-Paraplastic Kettle 1-Air Comp. 1-Router 1 or 2-Sign Trucks/ Sign Trailers	1-Crew Carrier 1-Dump Truck 1-Mtce. Kettle 1-Air Comp.	1-Crew Carrier 1-Dump Truck 1-Paraplastic Kettle 1-Air Comp. 1-Router
MATERIALS	Asphalt Sand or Stone Chips	Rubberized Asphalt	Asphalt Sand or Stone Chips	Rubberized Asphalt
ACCOMPLISHMENT	Litres	Litres	Litres	Litres
MANHOURS PER ACCOMPLISHMENT	0.066 - 0.11	-	0.06 - 0.12	-
ACCOMPLISHMENT PER DAY	970 - 600	-	1100 - 550	-

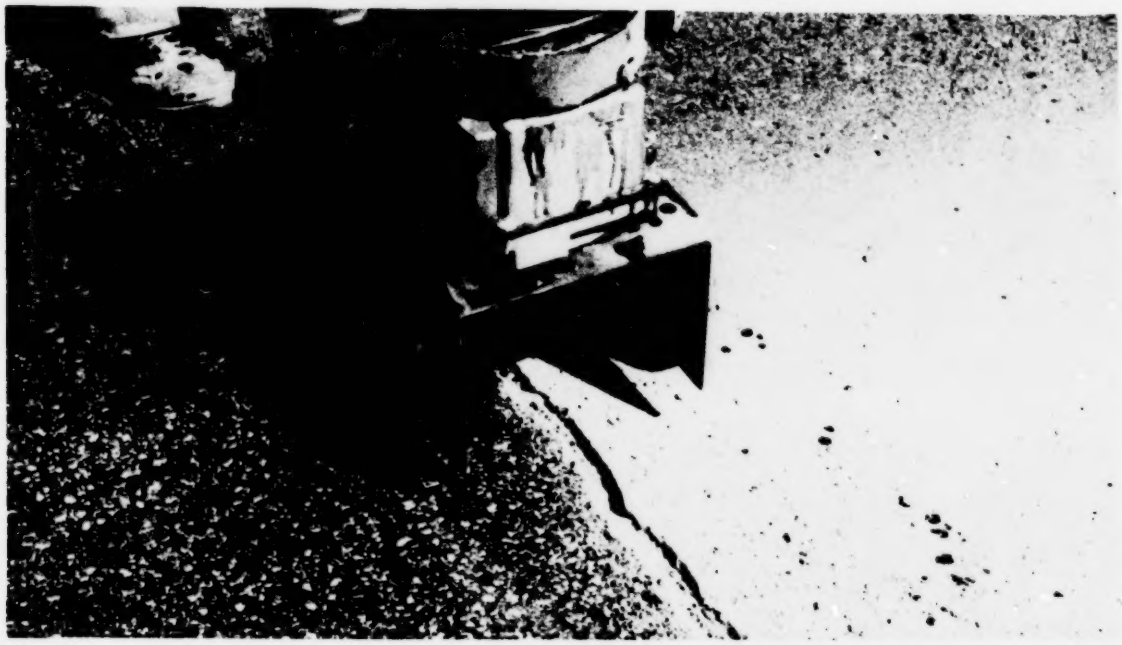
Recommended Method

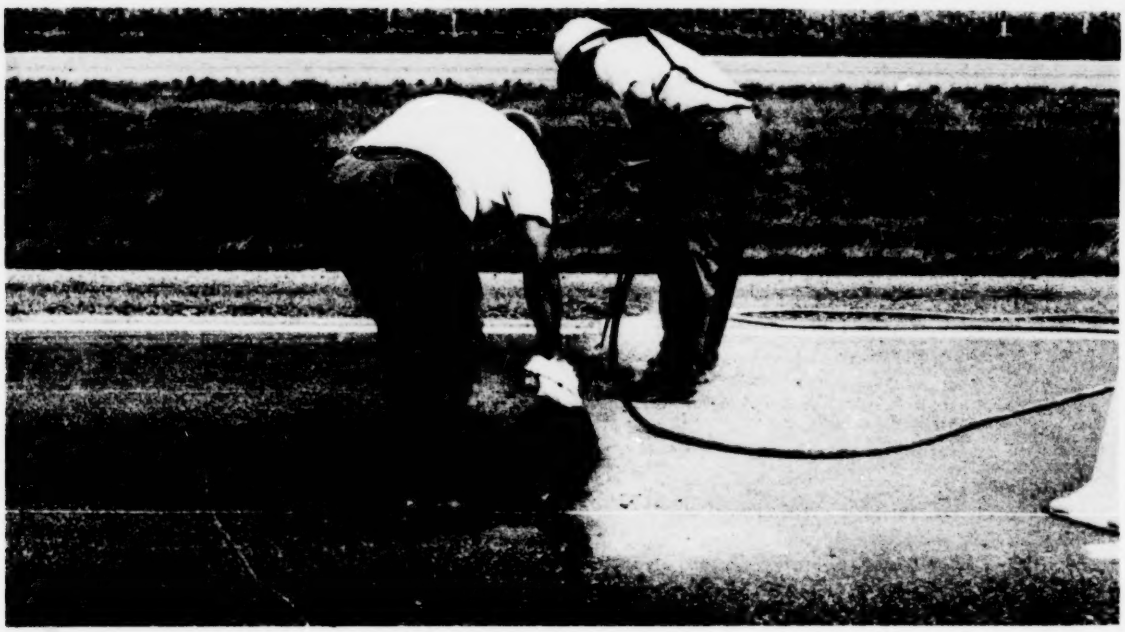
1. Set up safety devices and signs in accordance with "Traffic Control Manual for Highway Work Operations."
2. Designate the areas requiring repair.
3. (a) Clean out cracks using a stiff bristled broom and/or compressed air.

   (b) Rout cracks, remove dust and debris with compressed air.
4. Fill cracks with sealant; apply inside the crack to avoid creating a bump.

   Note: When using asphalt emulsion, sprinkle the surface of the filled crack with dry sand or stone chips.

Procedures for Crack Sealing





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MAINTENANCE PERFORMANCE STANDARD

page of

M-1004

Spray Patching

DESCRIPTION
The application of emulsified asphalt to localized areas of distressed pavement and pavement-edge defects, followed by spreading of aggregate (stone chips or sand). Includes minor crack-filling when performed during the patching operation.

ROAD TYPE		
HOT MIX CONCRETE MULTI-LANE	HOT MIX MULCH 2-LANE	PRIME AND SURFACE TREATED
CREW SIZE	2 to 3-Drivers 1-Spray Bar Opr. 2-Shovellers 1 to 3-Flagmen (Traffic Control)	2 to 3-Drivers 1-Spray Bar Opr. 2-Shovellers 1 to 3-Flagmen (Traffic Control)
EQUIPMENT	1-Crew Carrier 1 to 2-Dump Truck 1-Mtce. Kettle 1-Loader	1-Crew Carrier 1 to 2-Dump Truck 1-Mtce. Kettle 1-Loader
MATERIALS	Asphalt Emulsion RS1 Stone Chips or Sand	Asphalt Emulsion RS1 Stone Chips or Sand
ACCOMPLISHMENT	Litres	Litres
MANHOURS PER ACCOMPLISHMENT	0.04 - 0.07	0.04 - 0.07
ACCOMPLISHMENT PER DAY	1400 - 800	1400 - 800

Recommended Method

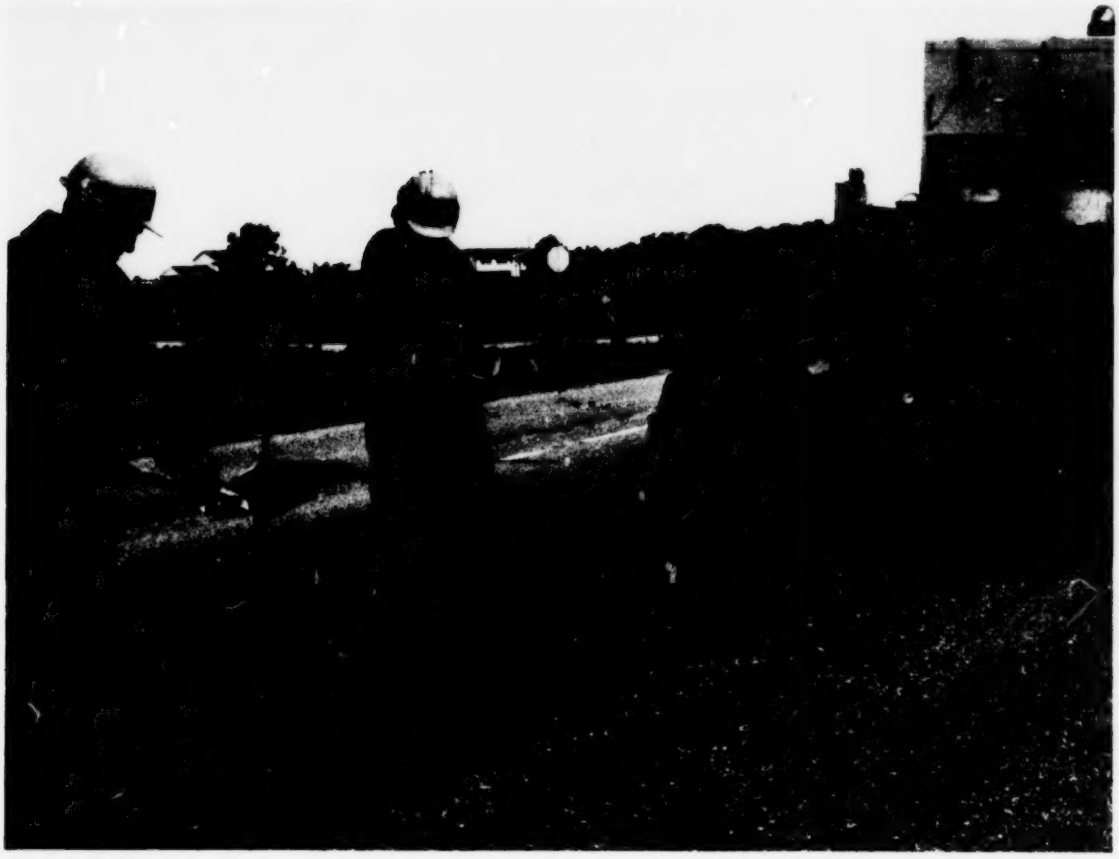
1. Set up safety devices and signs in accordance with "Traffic Control Manual for Highway Work Operations."
2. Clean the patch area; remove all loose material and debris.
3. When spray patching on primed or surface-treated roads, the patch areas should be compacted before repairs are made.
4. Spray the emulsion on the outside edges of the patch first, then spray the main area.
5. Apply the aggregate, spreading it to obtain an even coverage.
6. Sweep off loose aggregate around the patch.

Note: Double patches should not generally be applied in the same season. If a second lift must be applied, the first lift should be allowed to "set up" a minimum of 24 hours.

To avoid "pick-up", traffic should not normally be allowed to travel on the newly patched area immediately after the material has been applied.

If "flushing" is observed, add additional material.

Procedures for Spray Patching



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MAINTENANCE PERFORMANCE STANDARD page of

M-1014

Mulch Pavement — Mixed in Place

DESCRIPTION

The mixing and placing of mulch pavement at the road site. Includes hauling aggregate to site, formation of aggregate windrow, road mixing with grader or other specialized equipment, spreading and compacting mixture.

ROAD TYPE

PRIMED GRAVEL
MULCH SURFACE

CREW SIZE

(Operation Steps 1, 2, 3)

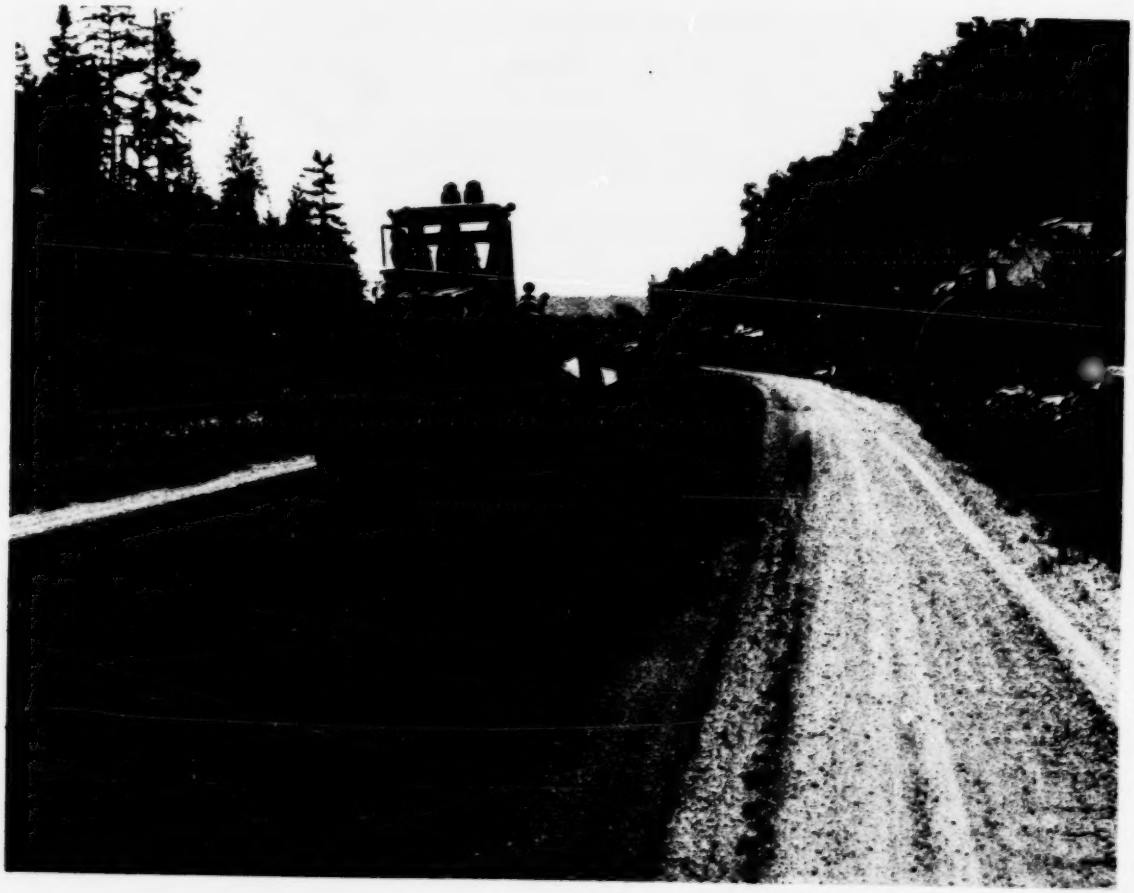
1/ Spreading and Windrowing	2/ Blade Mixing (or)	2/ Blade and Travel Mixing	3/ Laying and Rolling the Mix
1-Foreman 2-Grader Oprs. 1-Loader Opr. 1-Checker 2 to 3-Flagmen (Traffic Control)	1-Foreman 2-Grader Oprs. 2 to 3-Flagmen (Traffic Control)	1-Foreman 3-Grader Oprs. 2-Pulvi-Mixer Opr. 2 to 3-Flagmen (Traffic Control)	1-Foreman 3-Grader Oprs. 1-Roller Opr. 2 to 3-Flagmen (Traffic Control)

EQUIPMENT			
1-Crew Carrier 2-Graders 1-Loader Hired Trucks as Required	1-Crew Carrier 2-Graders 1-Asphalt Distributor (Hired)	1-Crew Carrier 3-Graders 2-Pulvi-Mixers 1-Asphalt Distributor (Hired)	1-Crew Carrier 3-Graders 1-Roller 1-Dump Truck 1-Trailer
MATERIALS Granular Material	M.I.P. MC 800 or MC 250	M.I.P. MC 800 or MC 250	
ACCOMPLISHMENT			Kilometres of each lane paved
MANHOURS PER ACCOMPLISHMENT			30
ACCOMPLISHMENT PER DAY			1.61

Recommended Method

1. Set up safety devices and signs in accordance with "Traffic Control Manual for Highway Work Operations" for all phases of the operation.
2. Prepare existing road surface to acceptable grade and base conditions, including priming of gravel surface.
3. Dry the aggregate by repeated windrowing and spreading.
4. Apply the liquid asphalt (cutback) to the dried aggregate.
5. Mix the asphalt and aggregate by repeated windrowing and flattening until thoroughly mixed.
6. Spread the mix over the road surface.
7. Fine grade to required thickness, width and cross-fall.
8. Compact the new surface by
   (a) a complete rolling after final grading.
   (b) a second rolling the next day.
9. Complete the operation by grading up shoulder material to edge of pavement.

Procedures for Mulch Pavement — Mixed in Place



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MAINTENANCE PERFORMANCE STANDARD page of

M-1017 (M-1017*)

Surface Treating (Sand Seal)

DESCRIPTION

The application on emulsified asphalt to continuous sections of road surface, followed by the spreading and rolling of aggregate.

(Sand Seal refers to a single surface treatment with fine aggregate).

ROAD TYPE

Primed Gravel, Surface Treated,
Mulch Surface, Hot Mix Surface

CREW SIZE

1-Foreman
2-Distributor Opr.
2-Tail-End Oprs.
2-Aggregate
Spreader Oprs.
1-Loader Opr.
1-Wobble Wheel
Roller Operator
1-Steel Wheel
Roller Opr.
1-Driver (Broom
and Convoy)
1-Broom Helper/
(Flagman)
2-Flagmen
(Traffic Control)

EQUIPMENT

1-Convoy and
Crew Carrier
2-Distributors
1-Aggregate
Spreader
1-Loader
1-Wobble Wheel
Roller
1-Steel Wheel
Roller
1-Trailer Type
Power Broom
1-Dump Truck
1-Trailer

Dump Trucks
(Hired)

MATERIALS

RS1-K, HF150S, HF250S } Asphalt Emulsion
} Aggregate

ACCOMPLISHMENT

Kilometres
each lane
treated

MANHOURS PER ACCOMPLISHMENT

5.5

ACCOMPLISHMENT PER DAY

22 lane-km

Recommended Method

1. Set up safety devices and signs in accordance with "Traffic Control Manual for Highway Work Operations." Traffic should be directed through the work site with warning signs, flagmen and a convoy truck.
2. Sweep the existing surface prior to applying the asphalt.
3. Spray the asphalt uniformly at the correct application rate and temperature.
4. Spread the aggregate uniformly over the sprayed surface. Remove excess aggregate.
5. Begin rolling immediately. Start with the wobble wheel roller, followed by the steel wheel roller. Roll from the low side into the high side.

Procedures for Surface Treating (Sand Seal)

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MAINTENANCE PERFORMANCE STANDARD page of

M-1090C

Cold Planing

DESCRIPTION

The major pavement surface rehabilitation consisting of removal of surface defects by scarifying, leveling and removing excess material.

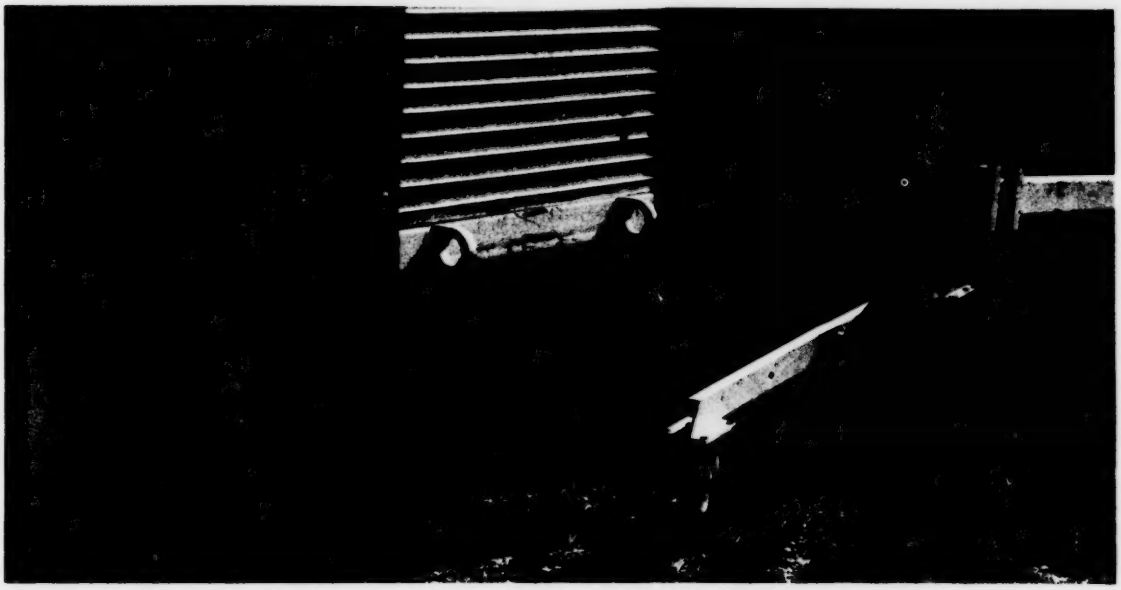
ROAD TYPE	
HOT MIX CONCRETE MULTI-LANE	HOT MIX 2-LANE
CREW SIZE	
1 to 3-Drivers 1-Planer Opr. 1-Broom Opr. 1-Loader Opr. 1 to 2-Drivers (Traffic Control)	1 to 3-Drivers 1-Planer Opr. 1-Broom Opr. 1-Loader Opr. 1 to 3-Flagmen (Traffic Control)
EQUIPMENT	
1-Crew Carrier 1 to 3-Dump Trucks 1-Self Prop. Cold Planer 1-Power Broom 1-Loader 1 or 2-Sign Trucks or Sign Trailers	1-Crew Carrier 1 to 3-Dump Trucks 1-Self Prop. Cold Planer 1-Power Broom 1-Loader
MATERIALS	
ACCOMPLISHMENT	
Square Metres	Square Metres
MANHOURS PER ACCOMPLISHMENT	
0.01	0.01
ACCOMPLISHMENT PER DAY	
7500	7500

Recommended Method

1. Set up safety devices and signs in accordance with "Traffic Control Manual for Highway Work Operations."
2. Premark the areas requiring repairs.
3. Plane the area(s) to a smooth surface, removing the distortion.
4. Clean up and haul away the material removed.

   Note: If required, cover the planed surface with a surface treatment.

Procedures for Cold Planing



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MAINTENANCE PERFORMANCE STANDARD page of

M-1090H

Heater Planing

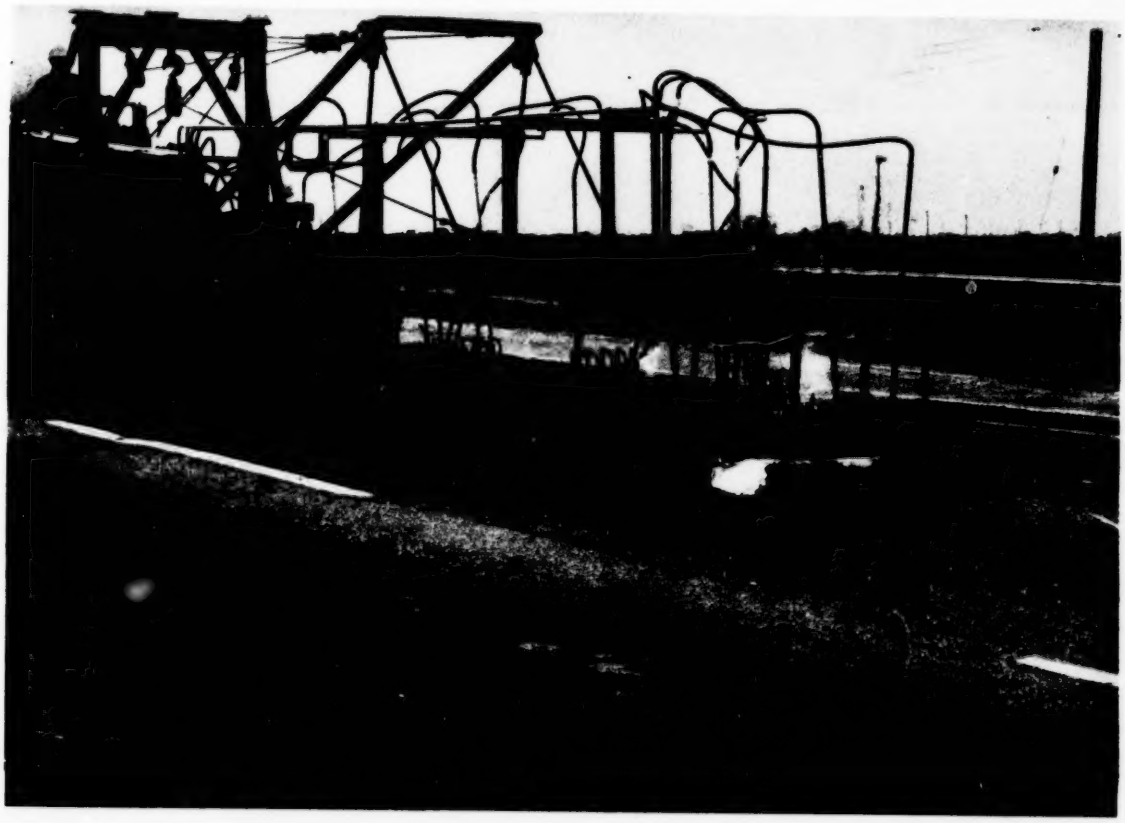
DESCRIPTION	
The major pavement surface rehabilitation consisting of removal of surface defects by heating, scarifying and leveling. Also includes removing excess material if necessary.	
ROAD TYPE HOT MIX MULTI-LANE	HOT MIX 2-LANE
CREW SIZE 1-Driver 1-Planer Opr. 1-Roller Opr. 1-Loader Opr. 2-Sweepers/ Shovellers 1 to 2-Drivers (Traffic Control)	1-Driver 1-Planer Opr. 1-Roller Opr. 1-Loader Opr. 2-Sweepers/ Shovellers 1 to 3-Flagmen (Traffic Control)
EQUIPMENT 1-Crew Carrier 1-Dump Truck 1-Heater Planer 1-Steel Wheel Roller 1-Loader 1 or 2-Sign Trucks or Sign Trailers	1-Crew Carrier 1-Dump Truck 1-Heater Planer 1-Steel Wheel Roller 1-Loader
MATERIALS	
ACCOMPLISHMENT Square Metres	Square Metres
MANHOURS PER ACCOMPLISHMENT	
0.03	0.03
ACCOMPLISHMENT PER DAY	
2500	2500

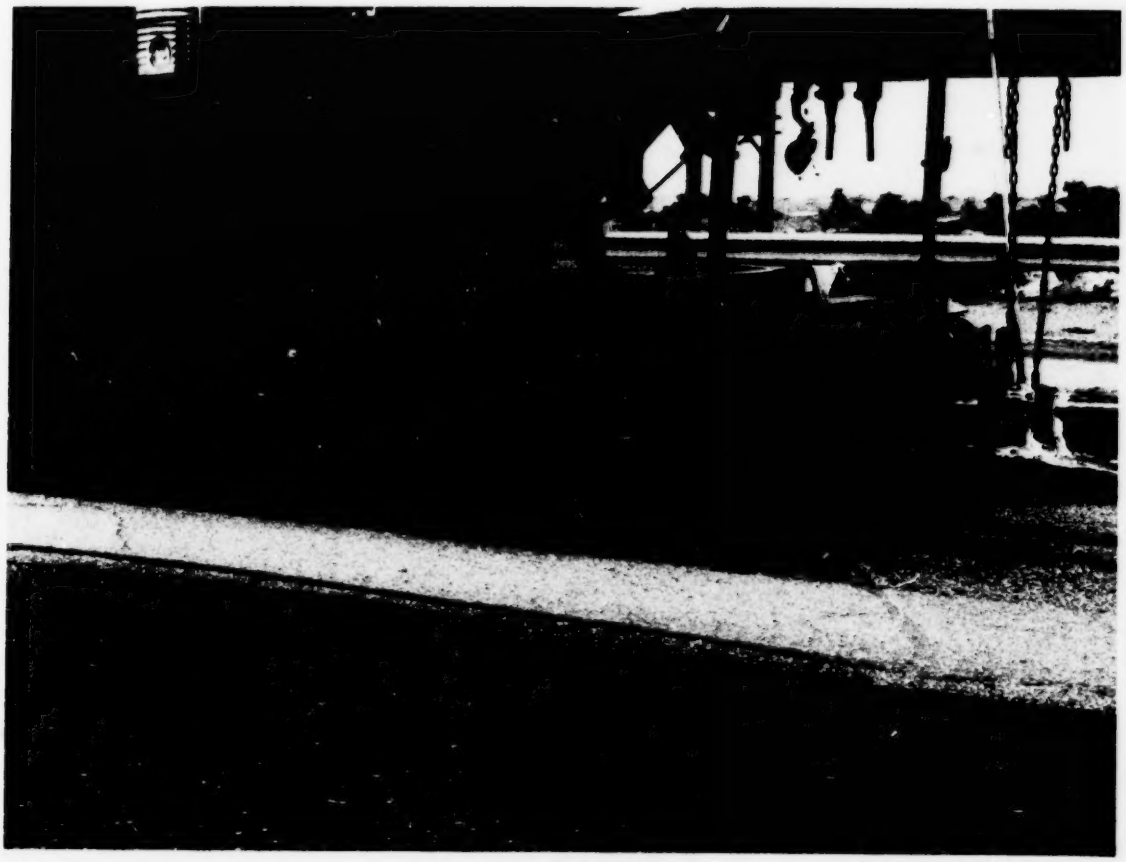
Recommended Method

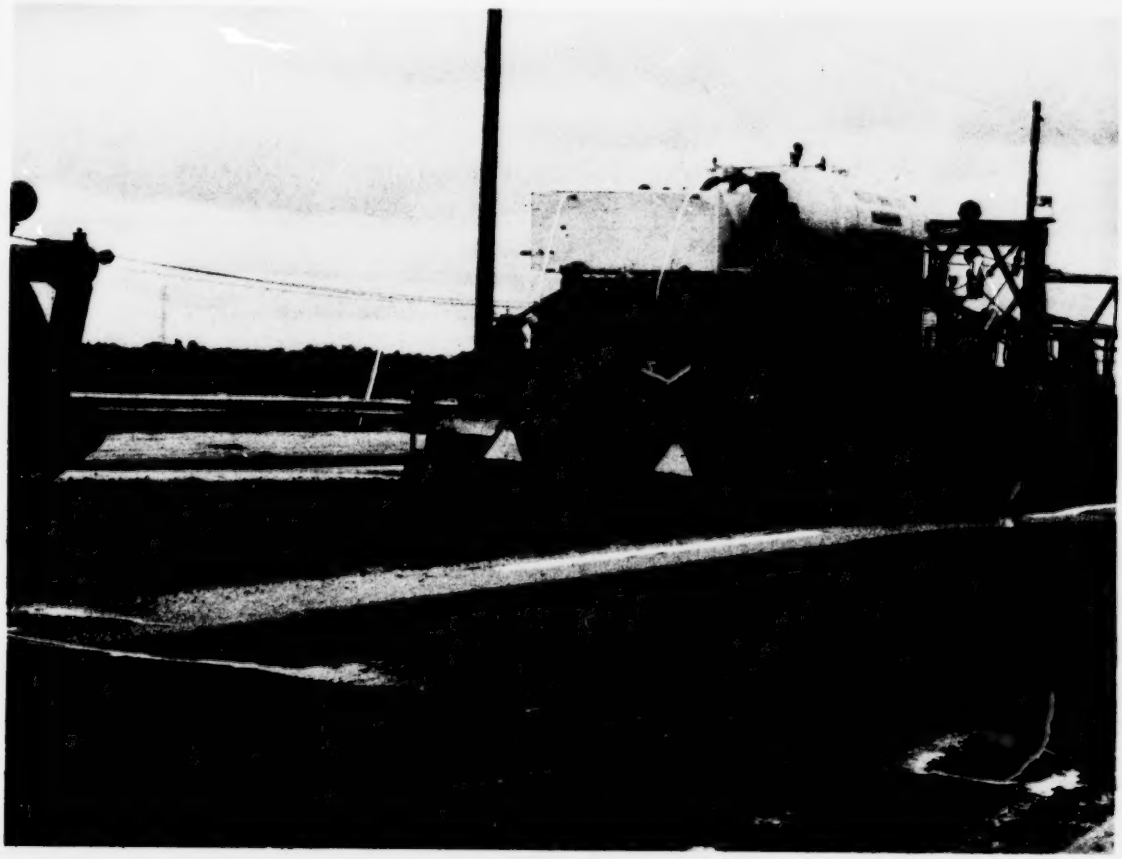
1. Set up safety devices and signs in accordance with "Traffic Control Manual for Highway Work Operations."
2. Premark the areas requiring repairs.
3. Plane the area(s) to a smooth surface, removing the distortion.
4. Roll the planed surface.
5. Clean up and haul away the material removed.

   Note: If required, cover the planed surface with a surface treatment.

Procedures for Heater Planing







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MAINTENANCE PERFORMANCE STANDARD page of

M-1090B

Burn (and Seal) Asphalt Pavement

DESCRIPTION	
The elimination of excess surface asphalt, commonly called bleeding or flushing, by burning.	
ROAD TYPE HOT MIX MULTI-LANE	HOT MIX 2-LANE
CREW SIZE 1-Driver 1-Burner Opr. 1-Labourer 1 to 2-Drivers (Traffic Control)	 1-Driver 1-Burner Opr. 1-Labourer 1 to 3-Flagmen (Traffic Control)
EQUIPMENT 1-Pickup Truck 1-Pavement Burner 1 or 2-Sign Trucks or Sign Trailers	1-Crew Carrier 1-Pavement Burner
MATERIALS	
ACCOMPLISHMENT Square Metres	Square Metres
MANHOURS PER ACCOMPLISHMENT	
0.68	0.68
ACCOMPLISHMENT PER DAY	
60	60

Recommended Method

1. Set up safety devices and signs in accordance with "Traffic Control Manual for Highway Work Operations."
2. Remove the asphalt film from the area; forward speed approximately 3 to 5 metres per minute.

Note: Apply either a surface treatment or a seal coat after treatment. (See appropriate Performance Standard.)

The burner should travel into the wind to prevent flames from being forced under the truck. Crosswinds are detrimental because they force the flames to fluctuate, causing uneven burning and forcing the flames out from under the hood. The burners must be shut off when trucks with flammable cargo are passing the operation. Ideal air temperatures for burning operations are 29° to 32°C. Operations at lower air temperatures cause excessive fuel usage. Fire prevention equipment should be provided when operating through areas of fire hazard.

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MAINTENANCE PERFORMANCE STANDARD page of

M-1005

Joint Sealing — Concrete Pavement

DESCRIPTION
The removal and/or replacing of joint filler and sealants, etc.

ROAD TYPE
MULTI-LANE
CONCRETE

CREW SIZE
1-Foreman
2-Drivers
1-Router Opr.
2-Sealant Installers

1 to 2-Drivers
(Traffic Control)

EQUIPMENT
1-Crew Carrier
1-Dump Truck
1-Compressor
1-Joint Router
1-Mtce. Kettle

1 or 2-Sign Trucks
or Sign Trailers

MATERIALS
Joint Filler/
Sealants

ACCOMPLISHMENT
Metres of
joints sealed

MANHOURS PER ACCOMPLISHMENT
0.03 - 0.07

ACCOMPLISHMENT PER DAY
700 - 1600

Recommended Method

1. Set up safety devices and signs in accordance with "Traffic Control Manual for Highway Work Operations."
2. Rout out old seal (and filler if present) to a depth of 3 cm.
3. Clean the vertical faces of the joint and remove foreign materials from the pavement surface at least 3 cm on each side of the joint.
4. Blow out joints with compressed air at a pressure of at least 620 kpa with 71 dm^3/S of air at the nozzle.
5. Insert sponge rubber, plastic, or tape to the bottom of the groove.
6. Seal in one pour. (The outer ends of transverse joints must be dammed to prevent sealing material from running out on to the shoulder.)

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MAINTENANCE PERFORMANCE STANDARD page of

M-1090M

Mud Jacking — Concrete Pavement

DESCRIPTION

The re-establishment of the base under Portland cement concrete pavement. Raising sunken slabs to Grade by pumping a concrete slurry underneath.

ROAD TYPE

MULTI-LANE
CONCRETE

CREW SIZE

1-Foreman
2-Drivers
1-Grout Pump Opr.
1-Jackhammer Opr.
1-Drill Opr.
2-Labourers

1 to 2-Drivers
(Traffic Control)

EQUIPMENT

1-Crew Carrier
2-Stake Trucks
1-Dump Truck
1-Grout Pump Mixer
1-Water Truck
1-Air Comp.
1-Drill
1-Jackhammer
1-Generator
1 or 2-Sign
Trucks/Sign
Trailers

MATERIALS

Concrete Slurry
Mix

ACCOMPLISHMENT

Square Metres

MANHOURS PER ACCOMPLISHMENT

0.53 - 1.07

ACCOMPLISHMENT PER DAY

75 - 151

Recommended Method

1. Set up safety devices and signs in accordance with "Traffic Control Manual for Highway Work Operations."
2. Drill holes in slab on a 2.5 m grid.
3. Pressure grout until pavement reaches original grade.
4. Plug holes.
5. Clean up.
6. Wait until initial set occurs in grout before opening to traffic.

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MAINTENANCE PERFORMANCE STANDARD

page of

M-1012

Concrete Pavement Repair with Concrete

DESCRIPTION

Repairs to holes, blow-ups, spalled areas, scaled areas, etc., where the repair is done with concrete.

ROAD TYPE	
MULTI-LANE CONCRETE	MULTI-LANE CONCRETE

CREW SIZE			
Precast Slab		Ready-Mix Concrete, Mobile Mix, Site Mix	
1-Foreman	*1-Welder (if reqd.)	1-Foreman	4-Labourers
1-Driver		2-Drivers	
1-Float Opr.		1-Loader Opr.	1 or 2-Drivers (Traffic Control)
1-Crane Truck Opr.	1 or 2-Drivers (Traffic Control)	1-Roller Opr.	
1-Loader Opr.		2-Jackhammer Opr.	
1-Roller Opr.		1-Concrete Saw Opr.	
2-Jackhammer Opr.			
1-Concrete Saw Drill Operator			

EQUIPMENT			
1-Crew Carrier	1-Air Drill	1-Crew Carrier	1 or 2-Sign Trucks/ Sign Trailers
1-Dump Truck	1-Arc Welder (if required)	2-Dump Trucks	
1-Tractor and Float Trailer	1 or 2-Sign Trucks/Sign Trailers	1-Loader	
1-Crane Truck		1-Air Compr.	
1-Loader		2-Jackhammers	
1-Roller		1-Concrete Saw	
1-Air comp.		1-Roller	
2-Jackhammers		1-Cutting Torch	
1-Concrete Saw		1-Concrete Vibrator	

MATERIALS	
Pre-Cast Slabs	Portland Cement Concrete

ACCOMPLISHMENT	
Square Metres of pavement repaired	Square Metres of pavement repaired

MANHOURS PER ACCOMPLISHMENT	

ACCOMPLISHMENT PER DAY	

* Usually contract work.

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MAINTENANCE PERFORMANCE STANDARD page of

M-1090V

Cut Full Depth Stress Relief Joints

DESCRIPTION

The installation of relief joints in concrete pavement to prevent joint blow-ups.

ROAD TYPE

MULTI-LANE
CONCRETE

CREW SIZE

1-Foreman
2-Drivers
2-Jack-hammer Opr.
1-Concrete Saw Opr.
2-Labourers

1 or 2-Drivers
(Traffic Control)

EQUIPMENT

1-Crew Carrier
2-Dump Truck
1-Air comp.
2-Jackhammers
1-Concrete Saw
1-Mtce. Kettle

1 or 2-Sign Trucks/
Sign Trailers

MATERIALS

Joint Filler
Material Cold Mix

ACCOMPLISHMENT

Lineal Metres

MANHOURS PER ACCOMPLISHMENT

2.32 - 4.8

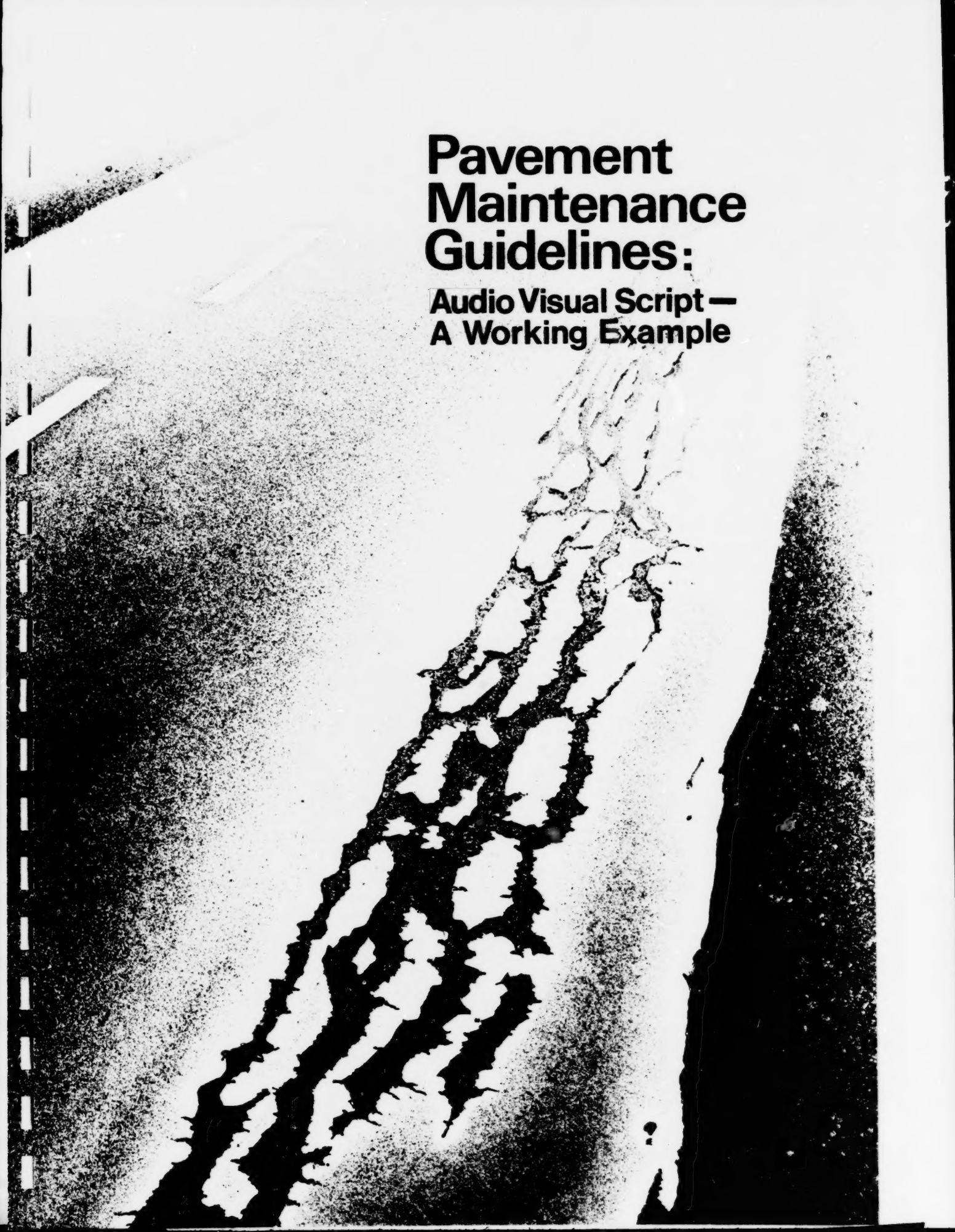
ACCOMPLISHMENT PER DAY

15 - 31

*Contract only

Pavement Maintenance Guidelines:

Audio Visual Script — A Working Example



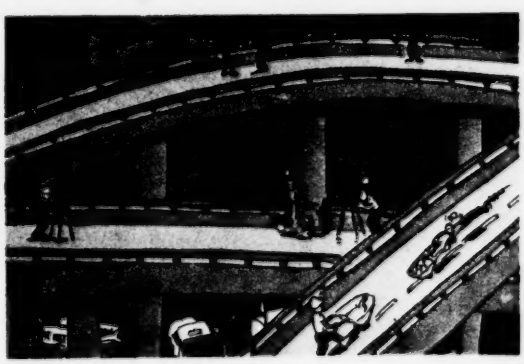
Appendix A

The appendix consists of the script and prints of a slide presentation, "Managing The Cost", which has been put together by MTC to help illustrate the guidelines outlined in this manual.

The complete audio-visual package is available on request.

Managing The Cost

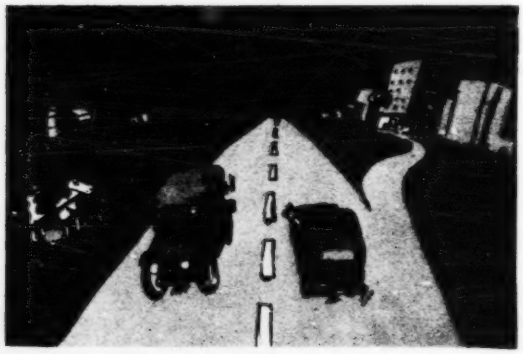
a guide to cost-effective pavement maintenance



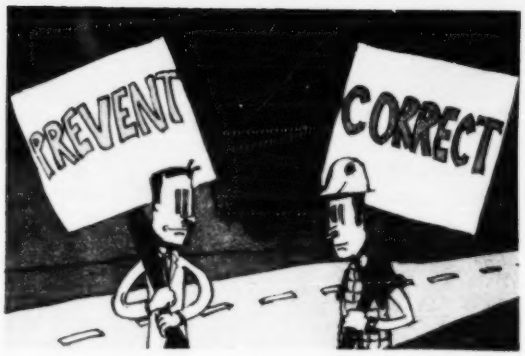
Not so long ago, the emphasis was on expansion. Everything had to be bigger and better. The standards for our highway system were continually being upgraded. Lots of roadway construction was underway.

In that time of growth, inflation was only a minor annoyance.

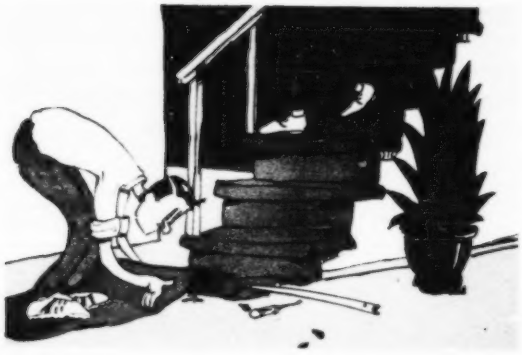
But nowadays, the picture is different. The twin-headed monster of tight money and rising costs has brought about a significant change.



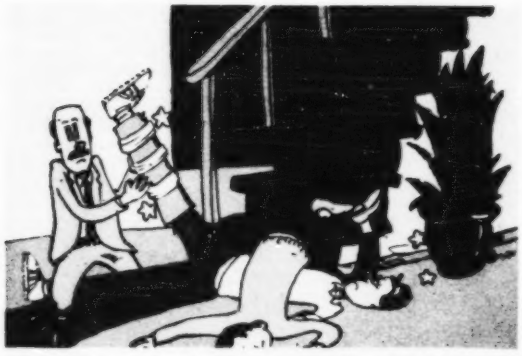
The emphasis now is on preserving what we have by maintaining and stretching the life of our highway pavements. This makes efficient pavement maintenance more important than ever.



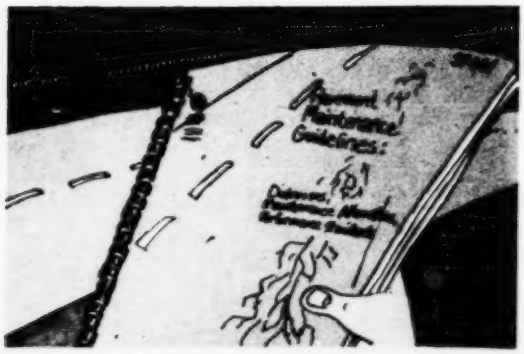
To make our maintenance task more cost-effective, the Ministry has developed a system – a strategy for pavement maintenance. This strategy has two aspects: Preventive Maintenance and Corrective Maintenance.



In preventive maintenance, we try to head off trouble before it starts. The aim is to prevent premature deterioration and to slow the progress of existing defects. This way, any loss in service standard can be controlled. Preventive maintenance is usually a long-term situation. The regional geotechnical office plays the leading role but with your support.



In corrective maintenance, we've already got trouble. The job is to correct deficiencies before they become hazardous, and to repair distresses which could lower the pavement performance. Corrective maintenance is usually a short-to medium-term situation –the daily concern of the field maintenance staff.



It is corrective maintenance that we're going to talk about today. "Pavement Maintenance Guidelines", designed specifically for Maintenance Field Staff, has been put together by the Ministry. Every day you are faced with problems in the field, and every day you must decide how to deal properly with each problem of pavement distress.

the guide: the best decision is the most cost-effective

The major objective of the guide is to help you to make the best decision – the decision which is most cost-effective. In order to do this, the guide offers four areas of assistance:

(1) simple and easy way of identifying the problem

(1) A simple and easy way to identify and describe the problem.

(2) list of treatments and when to use them

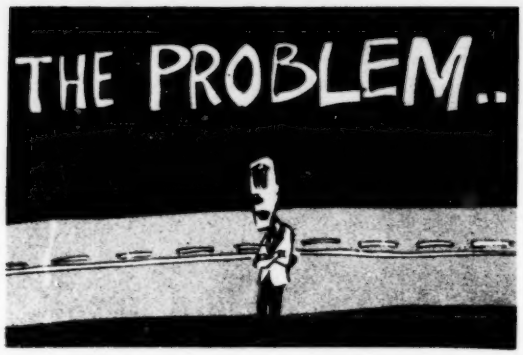
(2) A list of suitable treatments to correct the problem, and directions on when to use them.

(3) performance standard for manpower & equipment needs

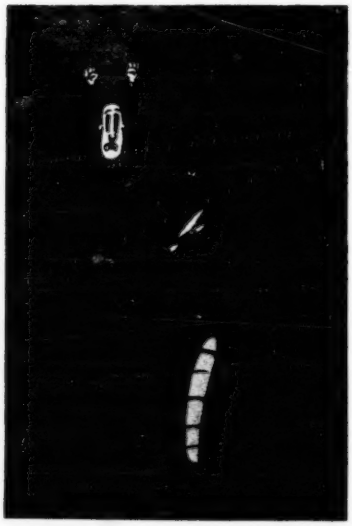
(3) A performance standard which tells you the men, equipment and materials you'll need to do the job under different conditions, and how long it will take. Knowing this, you can determine the unit cost for each type of treatment.

(4) identify most cost-effective treatment

(4) A simple method of finding out which treatment is the most cost-effective.

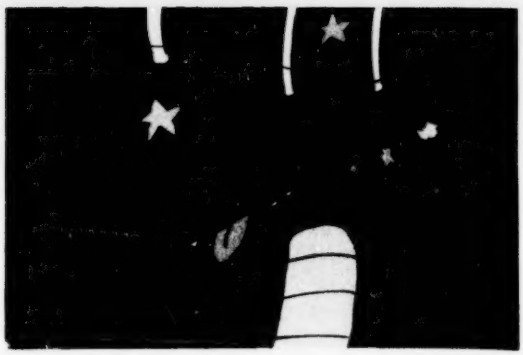


Right! Now that we've identified our four easy steps, let's take a closer look. First, there's The Problem. . .

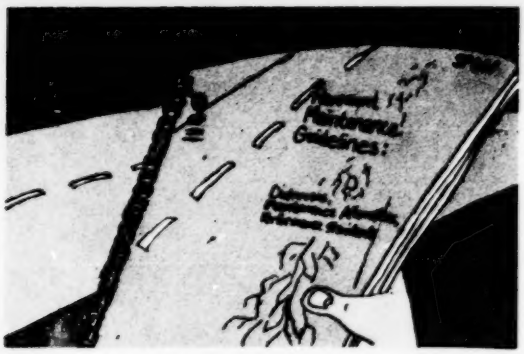


Life without problems would be simple, wouldn't it? Simple, but dull. This lucky fella hanging from the tree doesn't need to worry about being bored. He has a problem to solve.

His first step must be to identify his problem.



Once he knows the nature of the problem, he can do something about it.



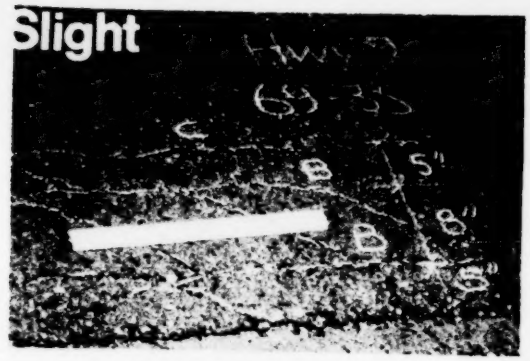
Now let's apply this to pavements and see how the guide works. Take this problem as an example.

First, using the guide, identify the problem: give it a "name", check the photos, check the description of what it looks like, and read the brief summary of why it happens.

how bad is it?

uniform description	guidelines
slight	alligator pattern established with corners of polygon blocks fracturing
moderate	alligator pattern established with spalling of polygon blocks
severe	polygon blocks begin to lift; may involve pot holes

Next, use the guide to answer "How bad is it?" In very simple terms is it slight? moderate? or severe? The guide gives you a verbal description of each stage and it gives you pictures.



This is "slight" alligator cracking.

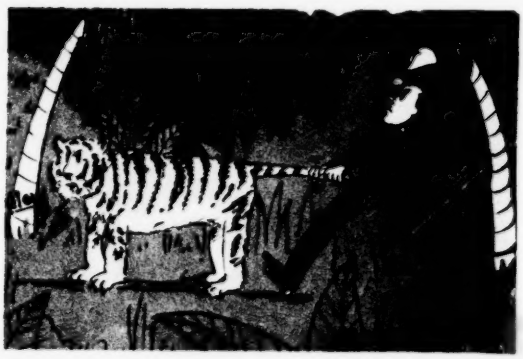
This is "moderate" alligator cracking.

And this is "severe" alligator cracking.

how big is it ?

local:	less than 30% of surface is affected; distress is spotted over localized areas only
general:	more than 30% of surface is affected; distress is spotted evenly over pavement section

Now that we know what, why, and how bad it is, we have to answer the question: "How big is it?" In other words, what is the degree of the problem? In our guide, problems only come in two sizes: local or general.



Now comes the tough part – we have to decide what to do about it. In the words of an old proverb: "We've got the tiger by the tail" – so what happens next? Well, all we do is consult the Guide.

Treatments for Alligator Cracking

Evaluation		Recommended Maintenance Treatment Alternatives
Severity	*Density*	
Slight	Local	No Action
	General	No Action but monitor closely for future development
Moderate	Local	Spray Patch
		Cold Mix Patch
		Hot Mix Patch
		Hot Mix Patch for multi-lanes
	General	Same as above but notify District Office of situation and maintain close monitoring
Severe	Local	Cold Mix Patch
		Hot Mix Patch

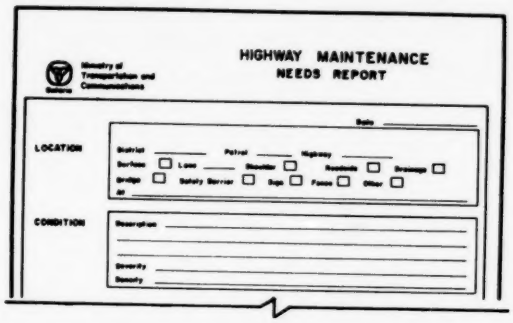
The guide contains a list of the treatments available to us. From this list we shall choose one treatment which solves our problem and, at the same time, is the most cost-effective.

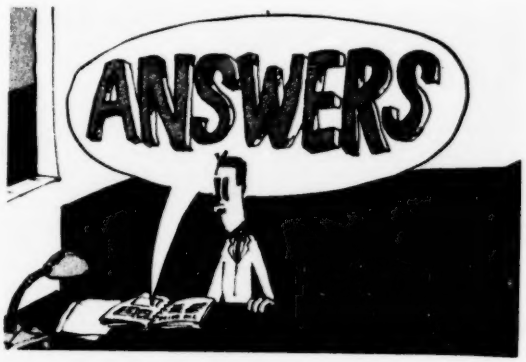
Treatments for Alligator Cracking

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification	
Severity	Density		Routine patrol	Non-patrol
Slight	Local	No Action		
	General	No Action but monitor closely for future development		
Moderate	Local	Spray Patch	1004	
		Cold Mix Patch	1001	
		Hot Mix Patch	1001 1002	1002
		Hot Mix Patch for multi-lanes		1002
	General	Same as above but notify District Office of situation and maintain close monitoring		
Severe	Local	Cold Mix Patch	1001	
		Hot Mix Patch	1001 1002	1002

Then we must decide who is going to carry out the work – can your patrol do it or is it just too big a job that must be done by combined patrol forces or by contract? The simple question here is "can I do it, or is it beyond my resources?"

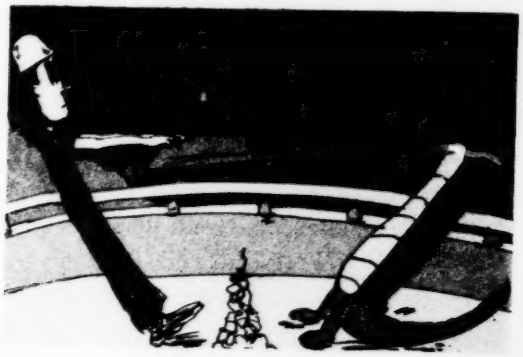
If you decide the job is too big for your patrol to handle, then you can submit the "Highway Maintenance Needs Report" to your district office.





After deciding WHO should do it, the question becomes HOW and to what standard. For each chosen treatment, the Guide tells you the manpower and equipment needed to do the job. It also tells how much work can be done each day given those men and equipment.

This is all based on past experience. We know the best crew size and the amount and type of equipment needed to lay a given amount of material in one day. This is our maintenance performance standard, and is available for every treatment. But we can't just do the job, we must do it cost-effectively. Now we're talking money!



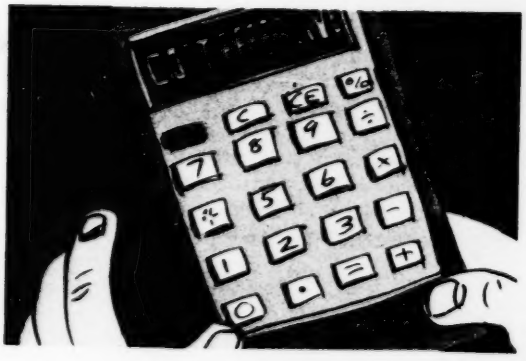
"How much treatment can we get for a dollar? Is this the best a dollar can buy?" To answer these questions, let's do some simple calculations.

(1) manpower spent

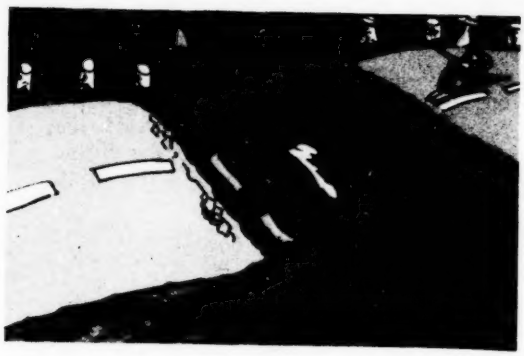
(2) equipment needed

(3) material used

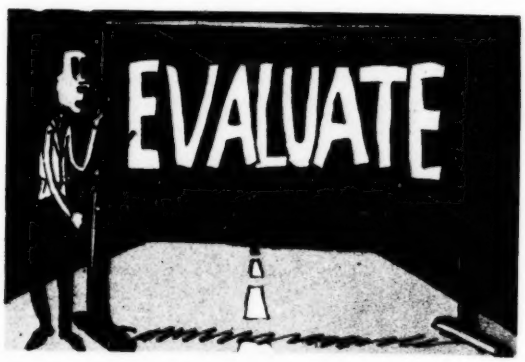
The cost of doing a job depends on 3 things:
1/ Manpower spent
2/ Equipment needed
3/ Material used.



Once the treatment is chosen, we simply add up these three and we know how much treatment can be bought for a dollar. But what about the second question "Is this the best a dollar can buy?"



Sometimes, the best way is the quickest way – but only if there's an emergency such as a wash-out. If the problem affects safety, it's got to be fixed right now and never mind your calculator.



Usually, though, we have time to consider and evaluate the problem, then carefully select the treatment that will give us the most value for our dollar. How do we compare the available treatments in dollars and cents? The answer lies in knowing how long each type of treatment will last – in other words, what is the "Effective Life" of the treatment. The way to compare alternatives is this:

$$\text{unit cost} = \frac{\text{manpower + equipment + material}}{\text{standard accomplishment/day}}$$

First, reduce all the expenses to a basic unit using this simple equation. From it, we see that the unit cost equals the combined costs of manpower, equipment and material, divided by the accomplishment for a day established by the Performance Standard.

unit cost vs life of treatment

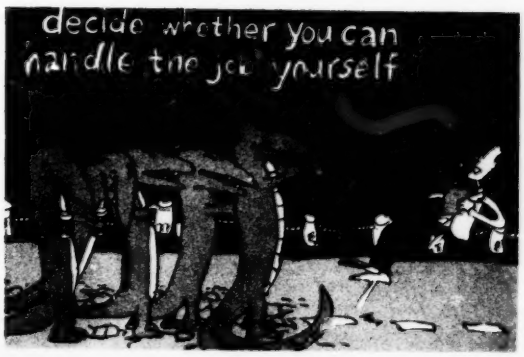
Next, we pit the unit cost against how long the treatment will last. The result is the Equivalent Annual Cost which is the actual cost of any particular treatment we happen to select. So! if we have a number of treatments to choose from, we can now make an easy judgement of which is the most cost-effective.

To sum up:

Ours is a winning system! Because you in the field can now:

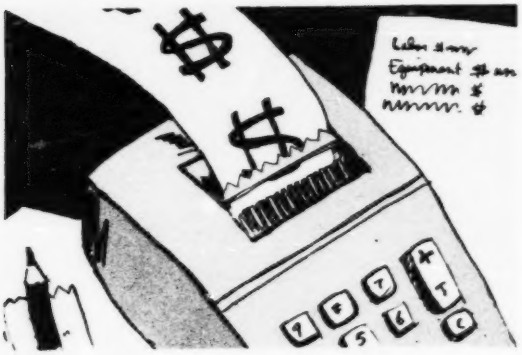
identify the problem and classify it as to severity and density;

choose the treatment that will best solve your particular problem; and

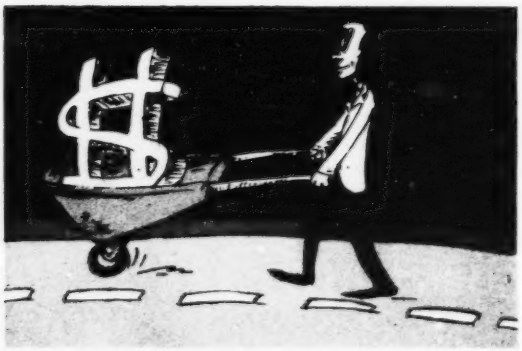


decide whether you can handle the job yourself.

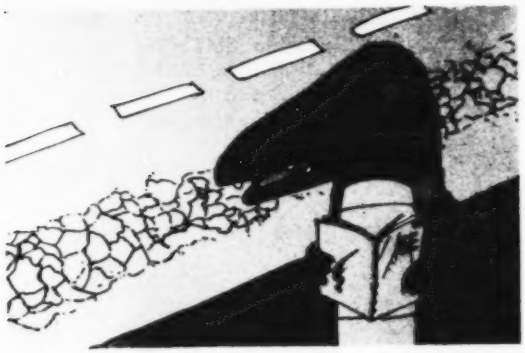
The system means that you know how long each treatment will last.



It means you can figure out the actual costs for each treatment available.



Then make your decision on what to do based on the best cost-effectiveness rating. Now that you know how the system works, let's work out an example:



Here's an old friend – alligator cracking. If we didn't know it so well we could look at the road, look at the book, make a positive I.D. and classify the problem as moderate and local.

Treatments for Alligator Cracking

Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	Density		Routine patrol	Non-patrol	
Moderate	Local	Spray Patch	1004		1
		Cold Mix Patch	1001		1
		Hot Mix Patch	1001 1002	1002	4
		Hot Mix Patch for multi-lanes		1002	4

In the guide there is a list of recommended treatments for this situation, giving three alternatives for a two-lane highway: spray patching, cold mix patching, and hot mix patching.

Treatments for Alligator Cracking

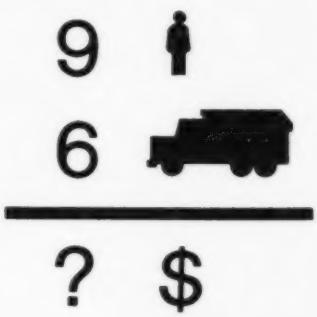
Evaluation		Recommended Maintenance Treatment Alternatives	Maintenance Function Classification		Expected Effective Life in Years
Severity	Density		Routine patrol	Non-patrol	
Moderate	Local	Spray Patch	1004		1
		Cold Mix Patch	1001		1
		Hot Mix Patch	1001 1002	1002	4
		Hot Mix Patch for multi-lanes		1002	4

Next, we decide that the problem isn't too big for us to handle, so we can go ahead and do it ourselves.

5. Performance Standards for Maintenance Treatments

To evaluate the cost of the job, we turn to the performance standards to find out the crew size, equipment needed, and amount of materials required to fulfill the daily accomplishment for each type of possible treatment.

Flexible Pavement		
Burn (and Seal) Asphalt Pavement	M-1000B	100
Cold Planing	M-1000C	102
Crack Sealing	M-1000	96
Grooving**	M-1000G	
Heater Planing	M-1000H	104



For example, for hot mix patching, performance standard 1002 says we need a 9-man crew, and six different pieces of equipment. So what is all that going to cost?

Sample Labour Cost Chart (Based on $8.05/hr Standard Provincial Labour Rate 1979/80)

Man in Crew	Hours Worked on Operation and Equipment Dollar Cost 1	2	3	4	5	6	7	8
1	8.05	16.10	24.15	32.20	40.25	48.30	56.35	64.40
2	16.10	32.20	48.30	64.40	80.50	96.60	112.70	128.80
3	24.15	48.30	72.45	96.60	120.75	144.90	169.05	193.20
4	32.20	64.40	96.60	129.00	161.00	193.20	225.40	257.60
5	40.25	80.50	120.75	161.00	201.25	241.50	281.75	322.00
6	48.30	96.60	144.20	193.20	241.50	289.80	338.10	386.40
7	56.35	112.70	169.05	225.40	281.75	338.10	394.45	450.80
8	64.40	128.80	193.20	257.60	322.00	386.40	450.80	515.20
9	72.45	144.90	217.35	289.80	362.25	434.70	[illegible]	579.60
10	80.50	161.00	241.50	322.00	402.50	483.00	[illegible]	644.00

Manpower costs are usually fixed at the start of each fiscal year. So a labour cost chart like this one available from your district office, gives you a quick and easy reference. One 9-man crew for this job is going to cost $579.60 per day.

There's a similar chart for equipment rental. The six pieces we need will cost $329.40 per day.

Pre-Identified Equipment Listing and Rental Rates

Description Type	MTC Equipment Code	Current (1979) Rental Rates $/hr
1/2 ton pick-up	0003	$3.00
3/4 ton pick-up	0006	3.10
3/4 ton 5 man cab	0006	3.10
1 1/2 ton stake/hoist	0023	
1 1/2 ton 5 man cab		
6 pieces of equipment		$329.40

9

6

70 tonnes/day

To find out the accomplishment expected of our crew, we look at the performance standards. From them, we discover that 9 men using six pieces of equipment can be expected to lay an average of 70 tonnes in a day.

$20.04/tonne

x 70

$1402.80

Location and time of year can alter the cost of materials, but reasonably accurate estimates can be obtained from the supplier or your district office. For example, at $20.04 per tonne, 70 tonnes of hot mix will cost $1402.80.

$579.60
329.40
1402.80
$2311.80 total cost/day

When we add all this up – $579.60 for manpower, $329.40 for equipment and $1402.80 for material – we end up with a grand total of $2311.80. This is the total cost per day for the job.

$$\frac{\text{total cost/day}}{\text{accomplishment/day}} = \text{unit cost}$$

$$\frac{\$2311.80}{70} = \$33.03$$

Now we have the total cost per day, we can work out the unit cost per day. To do this, we divide the total cost by the accomplishment per day: $2311.80 divided by 70, gives us a unit cost of $33.03.

Treatments for Alligator Cracking

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		Hot Mix Patch for multi-lanes		1002	4

One more variable has to be taken into account before we can reach a final figure for the actual cost of any job. Different treatments are going to last for different lengths of time. This affects actual cost over the years.

$$\frac{\text{unit cost}}{\text{expected life}} = \text{actual cost}$$

We can take this time factor into account by dividing the unit cost by the number of years we expect the treatment to have a useful life. The hot mix in our present example has an expected life of four years.

$$\frac{\$33.03}{4} = \$8.26 \text{ tonne/year}$$

In other words, the actual cost, or Equivalent Annual Cost, for hot mix patching (1002) is $33.03, which, you remember is our unit cost, divided by four, the years of expected treatment life, — $8.26 per tonne per year.

spray patching 77¢/L/year

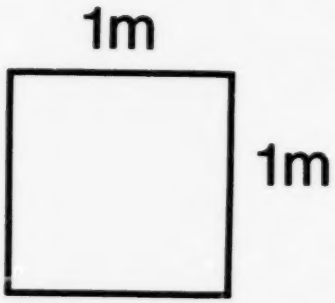
cold mix $35.47 tonne/year

We can work out the Equivalent Annual Cost for each of our other alternatives in the same way. Spray patching will cost 77¢ per litre per year. Cold mix will cost $35.47 per tonne per year.

equivalent annual costs

spray patching	cold mix	hot mix
77¢ L/year	$35.47 tonne/ year	$8.26 tonne/ year

Now let's compare the three Equivalent Annual Costs. Hot mix patching is obviously more cost-effective than cold mix. But how are we to judge spray patching?



This is well nigh impossible unless we go one step further and take into account the area of pavement we intend to repair and the quantity of materials to be used. The simplest way to do this is to reduce everything to a common unit of one square metre.

spray patching

1.8 L/m²

Let's start with spray patching. The standard quantity to be applied to one square metre is 1.8 litres.

Note: consult the Estimating Manual for standard quantities.

alligator cracking

40% increase

However, this quantity should be increased by 40% when the treatment's used to deal with our problem of alligator cracking.

1.8

+ 40%

2.5 L/m^2

So – if we increase 1.8 litres by 40%, we can say that the rate of application for spray patching in our job would be 2.5 litres per square metre.

1 L costs 77¢

2.5 cost $1.93

application cost

$1.93 /m^2/year

We know the Equivalent Annual Operation Cost of spray patching is 77¢ per litre per year so it's an easy task to work out the application cost as $1.93 per square metre per year.

hot mix
(0.0228 tonnes)

22.8 kg

1cm

The application rate of hot mix for one square metre is 22.8 kg, which is 0.0228 of a tonne. This will give a cover of one centimetre thickness.

equivalent annual cost

$8.26/tonne/year

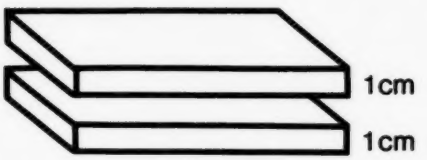
We've already worked out the Equivalent Annual Cost of hot mix patching to be $8.26 per tonne per year. So its relatively simple now to calculate the application cost for our job.

application cost

$8.26 x 0.0228

= 18¢/m^2

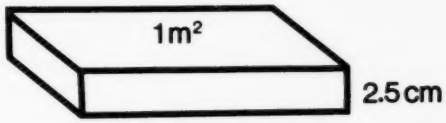
To work out the application cost, we multiply the Equivalent Annual Cost, in this case $8.26, by the standard application rate over one square metre, 0.0228 tonne. This gives an application cost of 18¢ per square metre.



36¢/m²/year
2.5 cm costs 47¢/m²/year

If we want to make our patch two centimetres in thickness, it's going to give us an application cost of 36¢ per square metre per year. If we make the patch 2.5 centimetres in thickness, the application cost will be 47¢ per square metre per year.

cold mix



$2.02 m²/year

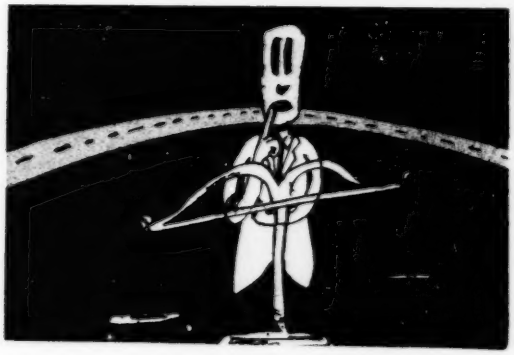
The application cost for cold mix can be worked out in the same way. For the job we're talking about here, a cold mix patch 2.5 centimetres thick, would cost $2.02 per square metre per year.

spray patching	cold mix	hot mix
$1.93	$2.02	47¢

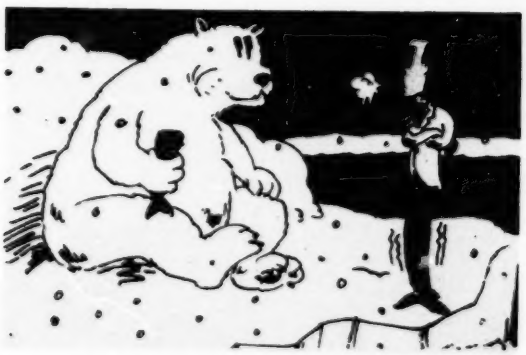
Now, let's line up the three treatments once again and compare their Equivalent Annual Cost for one square metre.

Hot mix patching is obviously the most cost-effective solution to our problem.

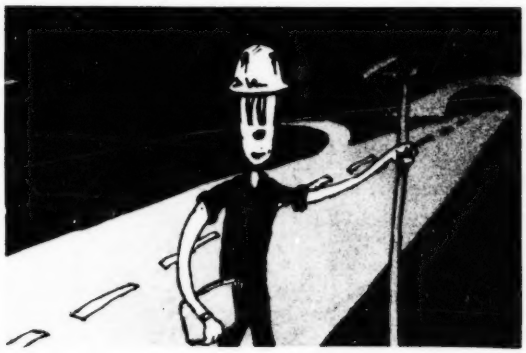
hot mix 47¢



The treatments recommended in the guide are the best currently available. From them, we must choose the one which will give us the best value for our dollar



But sometimes, special circumstances will mean that the most cost-effective treatment is not necessarily your best choice. For example, you may work in an area where hot mix is simply not available. So there's no point in your recommending it as the best available treatment – you have to stay with the the other two alternatives.



The system is really quite straightforward once you've used it a few times. Work out the equivalent annual cost of a treatment once, and you won't have to do it again — you can simply use it the next time a similar situation arises (unless labour, equipment or material costs have gone up a great deal from the last time). So remember — the system's a winning one. Let's use it!

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